...IVERSITY OF MICHIGAN
JUL 12 19

JULY, 1951

# METAL FINISHING

DEVOTED EXCLUSIVELY TO METALLIC SURFACE TREATMENTS
FOUNDED 1903


## ...ews of war... for peace

...World War II, Hanson-Van Winkle-Mun... worked closely with ordnance manu...rers in developing new methods for ...ision plating ordnance parts. Today ord...e manufacturers are again demanding ...ision plating which can be held to the ...st tolerances, and insure absolute uni...ity of surface. And again manufacturers ...rdnance rely on H-VW-M and Plate...hip for aid in solving their most in...te plating problems.

...what is Platemanship? It is H-VW-M's ...ue ability to . . .

...lace at industry's disposal a completely ...quipped laboratory for the develop...ent of newer and better plating proc...sses, equipment and supplies.

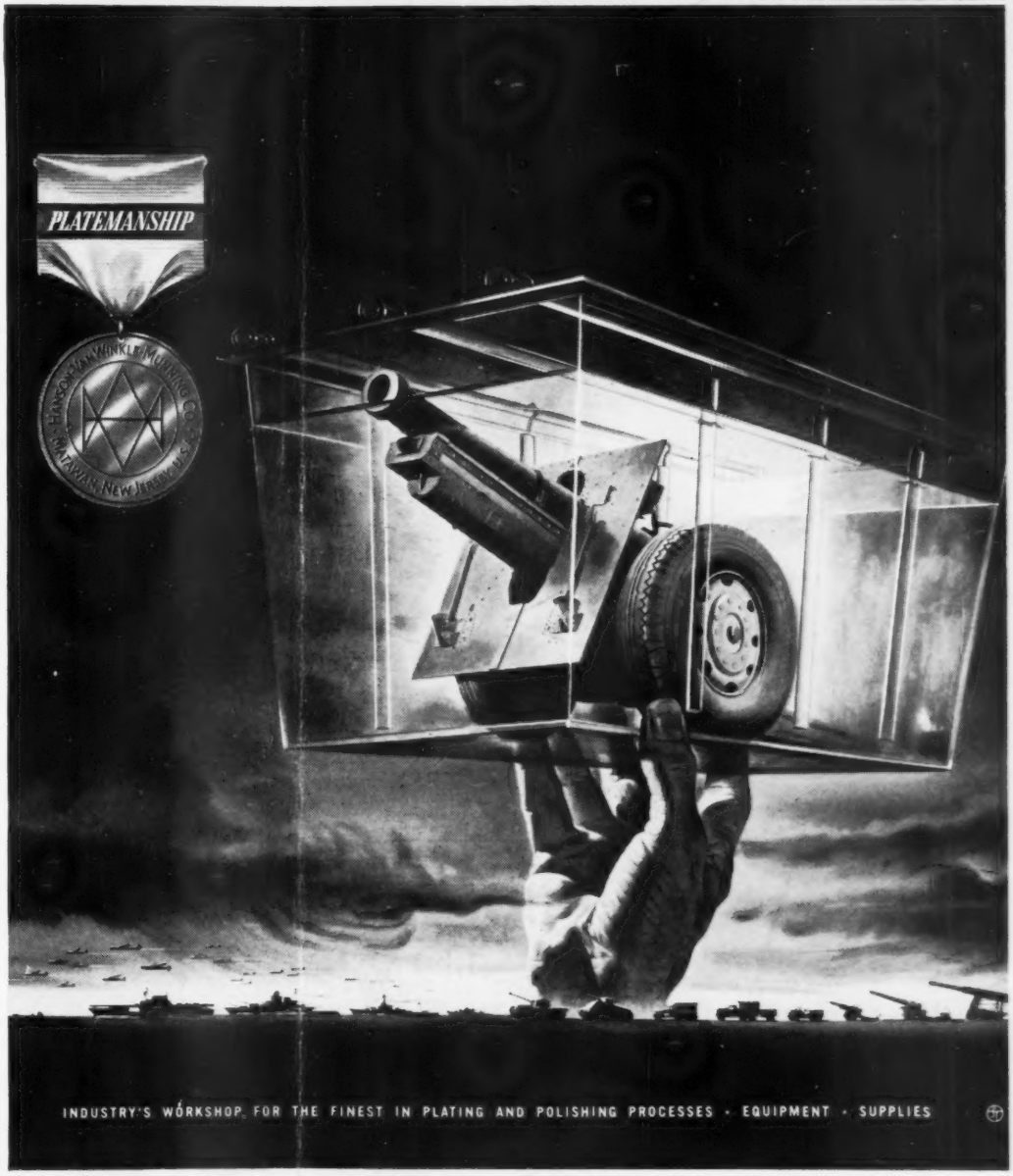
...ssume complete responsibility for every ...lating need, whether it is a polishing ...heel, a low-voltage generator, or an ...ndividually engineered, fully-automatic ...recision plating conveyor with spe...ially formulated processes

...raw upon an unparalleled fund of ex...erience and knowledge of every phase ...f plating, polishing, buffing, cleaning ...nd anodizing.

...ance makers, in their demand for pre... plating, are not the only manufac...rs who rely heavily on H-VW-M's Plate...hip. *All* industry looks to H-VW-M ...he solution of difficult plating problems ...complete, fully dependable service.

...M-VAN WINKLE-MUNNING COMPANY, MATAWAN, N. J.
...LANTS AT: MATAWAN, N. J. • ANDERSON, INDIANA
...FICES: ANDERSON • BOSTON • CHICAGO • CLEVELAND • DAYTON
... GRAND RAPIDS • MATAWAN • MILWAUKEE • NEW HAVEN
...K • PHILADELPHIA • PITTSBURGH • ROCHESTER • SPRINGFIELD (MASS.) • STRATFORD (CONN.) • UTICA

H·VW·M



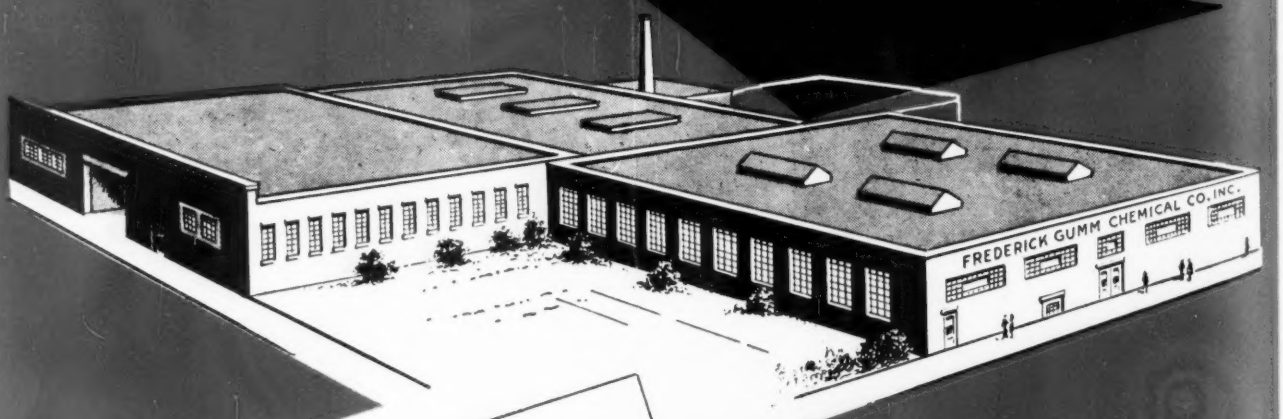

INDUSTRY'S WORKSHOP FOR THE FINEST IN PLATING AND POLISHING PROCESSES • EQUIPMENT • SUPPLIES


**THE METAL FINISHING INDUSTRY and the RE-ARMAMENT PROGRAM**
Contents Page 73

**ANNUAL CONVENTION**
**BUFFALO, N. Y.**
**JULY 30 - AUGUST 2**

# FURTHER EXPANSION TO HELP YOU MEET TODAY'S STEPPED-UP SCHEDULES!

You can depend on FREDERICK GUMM CHEMICAL COMPANY, INC., with their enlarged plant, to help you schedule your government orders for peak production efficiency.




*Welcome to the*
*American Electroplaters' Society*
*38th Convention*
*Buffalo, New York*
*July 30-31 August 1-2, 1951*

L E P C O
CLEANING COMPOUNDS

FREDERICK GUMM *Chemical Company Inc.*

538 FOREST STREET, KEARNY, N. J.

DEVOTED EXCLUSIVELY TO METALLIC SURFACE TREATMENTS

# METAL FINISHING

Founded as Metal Industry, January, 1903
by Palmer H. Langdon, 1868-1935

JULY, 1951 VOLUME 49 • NUMBER 7

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## COMING SOON

A new alloy electroplating process for depositing Tin-Nickel alloys having potential usefulness as a decorative finish.

A discussion of several devices that can be used to conserve water in the plating room.

Tarnish resistant treatments for silver plating and silverware.

A progress report on the status of belt polishing in the metal finishing industry.

**Editorial and Business Staff**

H. LANGDON, *Publisher*
LMER H. LANGDON, *Assistant Publisher*
OMAS A. TRUMBOUR, *General Manager*
AN T. WIARDA, *Sales Manager*
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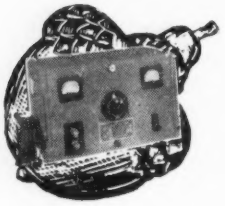
rbuted articles, communications, etc., on per- t subjects are invited. Their publication, how- does not necessarily imply editorial endorse-

# from LITTLE ACORNS

A FEW SHORT YEARS AGO . . . OUR FIRST SELENIUM RECTIFIER—A BENCH MODEL, CAPACITY 50 AMPERES

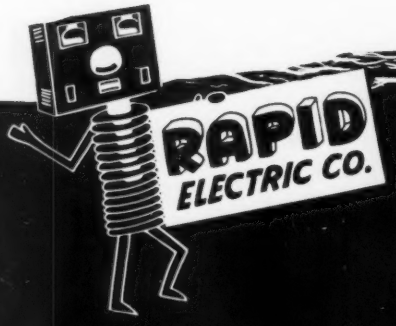


*On the occasion of the Electroplaters' 38th Annual Convention, we take this opportunity to thank the members of the industry for the confidence they have placed in us and our products.*

*We pledge ourselves to maintain the high standards of quality and service which you have come to associate with RAPID ELECTRIC rectifiers and controls.*

To-day

STOCK MODELS UP TO 5000 AMPERES — CUSTOM-BUILT UNITS FOR YOUR SPECIAL NEEDS




## RAPID ELECTRIC COMPANY

DESIGNERS AND MANUFACTURERS OF SELENIUM RECTIFIERS AND ASSOCIATED EQUIPMENT FOR THE ELECTROPLATING INDUSTRY.

2881 MIDDLETOWN ROAD, NEW YORK 61, N. Y.

OUR DISTRIBUTORS JOIN US IN THIS MESSAGE

CLINTON SUPPLY COMPANY
110-112 S. Clinton St., Chicago 6, Ill.

ELECTROPLATERS SUPPLY CO.
7426 Tioga Street, Pittsburgh 8, Pa.

THE PLATING PRODUCTS CO.
352 Mulberry Street, Newark 2, N. J.

SPECIAL CHEMICALS CORP.
30 Irving Place, New York 3, N. Y.

COPPER PLATED ART
235 W. Main Street, Los Gatos, Calif.

JOSEPH NOVARA CO.
6682 Crane Avenue, Detroit 13, Mich.

TECHNIC INC.
39 Snow Street, Providence 3, R. I.

# The WASHINGTON OBSERVER

George W. Grupp

*News and Views from The Nation's Capitol*

• On July 1st the Controlled Materials Plan began to affect the production of such metal finishing equipment as buffing and polishing machines and wheels, tank heaters, tanks, cranes and hoists, water softeners, fractional horsepower motors, electrical control equipment, industrial process instruments, and silverware and plateware.

• Cadmium Order M-19 will be amended to permit a wider usage of this metal. This is possible because of the current substantial stockpile of this metal. The amended order is expected to relax some of the restrictions on the usage of this metal for pigments and plating.

• The electric housewares industry asked NPA for permission to use an additional small quantity of nickel for the flash plating of certain items to prevent corrosion. By using a small amount of nickel with copper for plating, the industry is presently conserving nickel.

• Zinc Orders M-9 and M-15 were amended to channel more special high grade zinc for the defense program and for essential civilian production. The use of high grade zinc is limited to 70% of base period usage, other grades to 80% of base period usage. Small users and substitution for cadmium plating are exempted.

• Plans are under way to increase this production of aluminum oxide and calcined bauxite, two materials used in the manufacturing of abrasives. At present the supplies are not sufficient; supplies for bonding abrasives are tighter today than in 1950.

• Maintenance, repair and operating supplies Regulation No. 4 was amended by the NPA to permit metal finishing shops and others to use the DO-97 rating for up to 120% of the amount spent for such MRO items during the base period. This amendment was made to compensate for increased prices.

• Order M-61 was issued by NPA to grant 3rd quarter production priority rating, DO-75, for the manufacturing of such equipment as grinding and polishing machines, industrial fans and blowers, electrical measuring instruments, motor generator sets and other rotating equipment, and industrial electrical control equipment.

• Use of .25 oz. tin plate has been permitted for canning powdered milk until July 31, for less than 5 gallon containers. Larger sized containers can use .5 oz. tin plate.

Flash

*Announcing*

# Lea Copper-Glo

## Something New in Bright High Speed Copper Plating

The Ronal Bright Copper Process* using Lea Copper-Glo is the answer to the platers' prayers because it answers the problem of extreme nickel shortages.

Lea Copper-Glo makes it practicable to plate properly prefinished steel and die-castings *directly* with chromium without any intermediate buffing operation. It makes it possible for you to forget your nickel worries.

**The user of Lea Copper-Glo enjoys numerous advantages as for example:**

OPERATING

- Brilliant ductile deposits
- High current density with 100% efficiency
- Exceptional throwing power
- No wetting agents required
- Direct, interrupted or periodic reverse current

COST SAVINGS

- Reduces tank plating time due to high speed operation. (Hull cell bright current density range 10-60 amp./ft.$^2$)
- Reduces rejects whether followed by bright nickel or otherwise; since it contains no wetting agents
- Reduces brightener costs to a few cents/100 gallons of plating solution per day

The Ronal Bright Copper Process using Lea Copper-Glo can be fitted into your plant operating cycle. Regular cyanide or Rochelle Copper baths can be readily converted to obtain these advantages. Write for further information. Or button-hole one of our men at the AES Convention in Buffalo.

**Ronal Bright Copper Process is a development of Ronal Chemicals, Brooklyn, New York, for which process patents are pending.*

Burring, Buffing and Polishing . . . Manufacturers and Specialists in the Development of Production Methods, Equipment and Compositions

**THE LEA MANUFACTURING CO.**
**16 Cherry Avenue, Waterbury 20, Conn.**
**LEA MFG. COMPANY OF CANADA, LTD.**
**370 Victoria Street, Toronto 2, Canada**

...SHED 1903
...O EXCLUSIVELY TO METALLIC SURFACE TREATMENTS
METAL FINISHING
...E 49 • NUMBER 6 • JULY 1951

# Metal Finishing and National Preparedness

Few civilians, and indeed not all platers, are fully aware of the vital importance attached to the proper protection of our military weapons against wear and corrosion. Contrary to popular opinion, the metal finishing industry does not suspend activities during a war production period—it merely converts from brightwork to functional or engineering applications, usually producing and consuming materials at a much higher than normal rate. In fact, many of the critical parts required in modern warfare can be produced only by the use of special plating techniques, such as electroforming.

This issue, together with the excellent program of technical papers to be presented at the Buffalo convention, will serve to point up the value of metal finishing activities to the Arsenal of Democracy.

W. A. Raymond

*Editor*

JOSEPH MRUK
MAYOR

CITY OF BUFFALO
OFFICE OF THE MAYOR

-: P R O C L A M A T I O N :-

WHEREAS, the general happiness, comfort, and satisfaction of our citizens depend on attractive and durable products which help to promote more leisure time, more enjoyment of that leisure time, and a higher standard of living; and

WHEREAS, many of our citizens are gainfully employed by local metalworking and metal-finishing industries which produce and market these products for the nation's benefit; and

WHEREAS, this community wishes to pay tribute to the importance of these activities to the growth and future accomplishments of its constituents,

NOW, THEREFORE, I, JOSEPH MRUK, Mayor of the City of Buffalo, do hereby designate July 30th, 1951, as official opening date of METAL FINISHING AND ELECTROPLATING WEEK coinciding with the opening day of the 38th annual convention of the American Electroplaters' Society in Buffalo, New York, sponsored by the Buffalo Branch of the American Electroplaters' Society, and call upon all departments of the city, its business and commercial organizations, civic clubs, and our citizens generally to take an active part in promoting the aims and objectives of this progressive and scientific program.

Joseph Mruk
Mayor

Buffalo's Mayor Mruk signs proclamation designating July 30 as Metal Finishing and Electroplating Week. Mrs. Wiarda, Publicity Chairman, Bert Kirchoff, Convention Chairman, and Bill Fotheringham, Convention Co-Chairman look on. Official Proclamation above.

William J. Neill
*Supreme President*

# 38th ANNUA
# AMERICAN ELECTRO
# July 30-3

Cleveland F. Nixon
*1st Vice-Pres.*

Franklyn J. MacStoker
*2nd Vice-Pres.*

Dr. George P. Swift
*3rd Vice-Pres.*

YOUR host, the Buffalo Branch, believes it has arranged the finest, most streamlined Convention ever made available for the entertainment and edification of the plating fraternity and their guests.

While keeping in mind the primary objective of the convention — to improve the technical and practical education of the platers attending — the committee has not overlooked a single item in providing a well-rounded social program as well.

The five technical sessions, prepared by capable men under the supervision and guidance of the A.E.S. Educational Board, will cover in a comprehensive manner the important technical problems of the day. Just when you think you cannot take any more chemical formulas or engineering facts, along comes the welcome relaxation of the social program to put you in shape for another round.

Just as the technical program aims at "Education — Not Prevarication," so does the social program strive for "Relaxation, but not Exhaustion."

From the opening welcoming address by *Mayor Mruk* on Monday morning to the last strains of "*Good Night, Ladies*" in the wee hours of Friday morning, the Buffalo Branch committee has tried to arrange for your complete enjoyment of the occasion.

As has been customary for many years, the social send-off will be the Open House Party on Monday evening in the Grand Ball Room. This annual affair is sponsored by the *International Fellowship Club*, without a doubt one of the most generous and anxious-to-please groups of manufacturers and distributors ever associated with a technical society. All registrants are invited by the Fellowship Club to eat, drink and be merry.

Another highlight of this year's affair will be the Annual Picnic at the Automobile Club in Clarence, a suburb of Buffalo. Come on out and see *Art Logozzo's* Eastern All-Star softballers try to make it two straight over the Western Wildcats. Whatever is lacking in finesse and agility will be made up by guile and skulduggery; at any rate it adds up to an afternoon of genuine fun. All sorts of games and contests will be held, with suitable awards to the winners.

NO SPEECHES is the order of the day for the final Banquet, which leaves the entire evening open for a luscious roast-beef dinner, dancing, presentation of awards, and general gaiety.

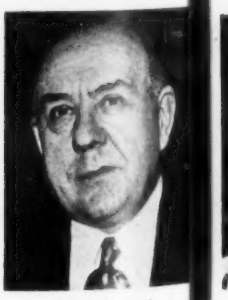
The Buffalo Branch guarantees a "Good time or your money back" during the week of July 30-August 2nd.

Arthur W. Logozzo
*Past President*

Dr. A. K. Graham
*Exec. Sec'y.*

Joseph Ruff
*Picnic*

W. D. Hart
*Registration*



Leon Nowak
*Transportation*

# CONVENTION

# PLATERS' SOCIETY

# August 1-2

Bert Kirchoff
*General Chairman*

### NEW DEVELOPMENT FORMULA #38-B

**Purpose:**

To make you deterioration-resistant and improve your appearance.

**Formula:**

You + 1500 other conventioneers + Buffalo + Hotel Statler. No rainwater is required, nor will any be supplied (we hope!). To make up this formula, just pack your grips and shuffle off to Buffalo. Mix well for best results.

**Operating Conditions:**

Temperature: 85-90°F.
Time: 4 days — July 30-August 2.
Density: 1500 Conventioneers, slightly charged (with enthusiasm, that is!)

The steps involved in making this formula work are:

1—Opening session
2—Fellowship luncheon
3—Technical sessions
4—International Fellowship Club Open House Party
5—Technical sessions special for ladies — Sightseeing trips
6—Picnic and Outing (we hope to eliminate rinsing at this point)
7—Golf tournament and East-West championship softball game
8—Annual meeting and banquet

This latest formula should prove to be even more successful than our previous formula No. 30, first tried out in 1943, and is guaranteed to give you a perfect finish, one that will be long-lasting and pleasantly remembered. The old-timers will agree that it is the best formula derived to date, and all newcomers will find it hard to duplicate. This exclusive formula was developed by the Buffalo Branch, but is not patented — anyone can use it! This is one time when drag-out is fun!

*"You will find that attendance*
*Will be worth while*
*Even your competitors*
*Will greet you with a smile!"*

**Bert Kirchoff,**
*General Chairman*

Wm. Fotheringham
*Co-chairman*

Dr. C. J. Wernlund
*Educational*

Stanley Bush
*Finance*

### GENERAL PROGRAM

FOR those planning to arrive in Buffalo on Sunday, July 29, a Registration Desk will be open until 8:00 p.m. There will also be a Hospitality Committee on hand to assist you.

The registration fee of $15.00 will entitle each registrant to a book of tickets to the various technical and social events of the week. All meetings and social affairs, unless otherwise stated, will be held in the headquarters hotel, the Hotel Statler.

Banquet table reservations must be

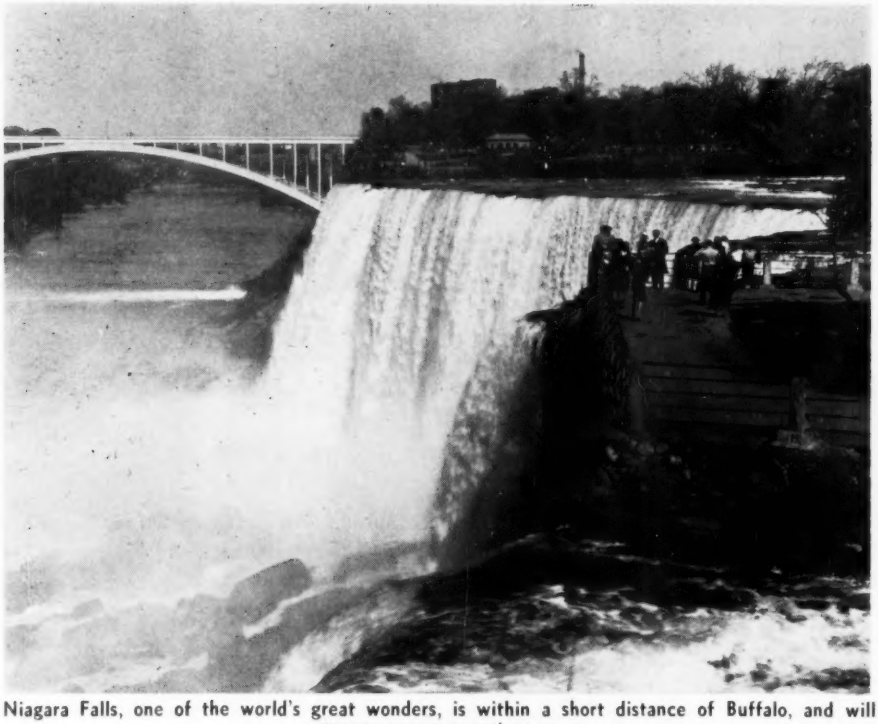
Anthony Nigro
*House*

B. P. Fortin, Jr.
*Hotel Reservations*

Jim Moneypenny
*Banquet*

Joan Wiarda
*Publicity*

H. A. Fudeman
*Program*



Niagara Falls, one of the world's great wonders, is within a short distance of Buffalo, and will attract many conventioneers.

made no later than Wednesday, 11 a.m. Tables will be assigned on a First Come First Served basis.

## Monday, July 30

**8:00 a.m.**

MEZZANINE LOUNGE

Registration all day.

**9:30 a.m.**

GRAND BALLROOM

Opening Session

Invocation—The Reverend *Frank C. Mesle.*
Welcome to Buffalo—*Joseph Mruk*, Mayor.
Greetings from the Buffalo Branch—*Bert Kirchoff*, President and General Chairman.

Keynote Address—"Electrodeposition Researches at the National Bureau of Standards"—*Dr. William Blum*, National Bureau of Standards.

**12:00 Noon**

TERRACE ROOM

Educational Committee Luncheon.

**12:15 p.m.**

EMPIRE STATE ROOM

International Fellowship Club, 27th Annual Luncheon—For Equipment and Supply Manufacturers, Distributors and their representatives only.

**2:00 p.m.**

GRAND BALLROOM

First Technical Session—"Engineering Aspects of Electroplating"—Chairman, *G. W. Jernstedt*, Westinghouse Electric Corp.

**8:30 p.m.**

GRAND BALLROOM

A Night of Food, Frolic and Fun—The contribution of our generous allies, The *International Fellowship Club*. Music - Dancing - Buffet (served at 10:00 p.m.)

## Tuesday, July 31

**7:45 a.m.**

CAFE ROUGE

Educational Committee Breakfast.

**9:00 a.m.**

MEZZANINE LOUNGE

Registration — Banquet Table Reservations.

**9:00 a.m.**

NIAGARA ROOM

Second Educational Session—"Preparation and Plating of Zinc Base Die Castings"—Chairman, *Dr. R. B. Saltonstall*, The Udylite Corp.

**12:00 Noon**

BUFFALO ROOM

Branch Secretaries' Luncheon Meeting — Courtesy Buffalo Branch.

**12:00 Noon**

TERRACE ROOM

Educational Committee Luncheon.

**3:00 p.m.**

GRAND BALLROOM

Third Technical Session—"Open Forum on Substitute Finishes for Electroplating" — Chairman, *Dr. Walter R. Meyer*, Enthone, Inc.

**7:00 p.m.**

BUFFALO ROOM

Annual Meeting of the National Association of Metal Finishers, Inc. Dinner Meeting.

TUESDAY EVENING FREE

## Wednesday, August 1

**7:45 a.m.**

CAFE ROUGE

Educational Committee Breakfast.

**9:00 a.m.**

MEZZANINE LOUNGE

Registration — Banquet Table Reservations must be made by 11:00 a.m.

**9:00 a.m.**

GRAND BALLROOM

Fourth Technical Session—"Some Practical Aspects of Plating Room Control"—Chairman *John Acheson*, Canadian Hanson-Van Winkle Co., Ltd.

**9:00 a.m.**

ORCHARD PARK COUNTRY CLUB

International Fellowship Club Golf Tournament, Orchard Park Country Club, Orchard Park, N. Y. Bus Transportation available — please fill out card in Registration Book.

**11:30 a.m.**

PARLOR A - MEZZANINE FLOOR

National Association of Metal Finishers, Inc. Board of Directors Meeting.

**12:15 p.m.**

Luncheon — Annual Picnic — Ball Game East vs. West. Buses will leave Delaware Avenue door, Hotel Statler for trip to Automobile Club, Clarence, N. Y.

WEDNESDAY EVENING FREE

## Thursday, August 2

**7:45 a.m.**

Combined Breakfast, Research and Educational Committees.

**9:00 a.m.**

NIAGARA ROOM

Fifth Technical Session—"Report on A.E.S. Research Program"—Chairman, *Guy Cole*, General Motors Corp., Ternstedt Div.

**2:00 p.m.**

NIAGARA ROOM

Final Business Meeting — American Electroplaters' Society.

**7:00 p.m.**

GRAND BALLROOM

Annual Banquet — Roast Beef — Good Music — Dancing. Drawing for *Hanson-Van-Winkle-Munning Co.* Gifts.

***The Buffalo Ladies Committee Prize-Winning Recipe for "The Busiest and Gayest Convention"***

## INGREDIENTS

MONDAY NOON

The Get Acquainted and Renew Acquaintance Luncheon, to be held in the Statler's beautiful Niagara Room.

MONDAY EVENING

The night of Frolic, Food and Fun in the Grand Ball Room, made possible by the *International Fellowship Club.*

TUESDAY MORNING

Bus trip to Niagara Falls (in case this was overlooked on your honeymoon), then on to the General Brock Hotel in Canada for the traditional Aunt Ella Society Luncheon, sponsored by the *Oakite Products, Inc.* The evening is free, so that you and your husband can compare notes to date.

WEDNESDAY

Off to the beautiful Automobile Club in Clarence, N. Y., for the annual picnic — luncheon, games, prizes and surprises.

THURSDAY

Our first Technical Session, to be held at 11 a.m., at the Empire State Room. *Dr. Saltonstall,* of the Udylite Corp., will divulge many "Platers' Secrets," after which the *Udylite Corp.* will be our host at a luncheon.

ICING

The Annual Banquet, held in the Grand Ball Room on Thursday evening. Lots of food, dancing and fun, but NO SPEECHES.

**Mrs. Anthony Nigro,**
*Chairlady*

# *Ladies Program*

**Parlor G - Mezzanine Floor will be Ladies Headquarters for the entire week.**

Mrs. Anthony Nigro
*Ladies Chairman*

### Monday, July 30

**8:00 a.m.**

MEZZANINE LOUNGE

Registration all day. Registration Fee $10.00.

**12:00 Noon**

NIAGARA ROOM

Get Acquainted and Renew Acquaintance Luncheon.

**8:30 p.m.**

GRAND BALLROOM

The Night of Food, Frolic and Fun — The contribution of our generous allies, *The International Fellowship Club* — Music - Dancing - Buffet served at 10:00 P.M.

### Tuesday, July 31

**10:00 a.m.**

Trip to Niagara Falls, then on to Canada (Please bring identification to prove citizenship.)

Aunt Ella Society Luncheon — General Brock Hotel, Niagara Falls, Canada. Sponsored by *Oakite Products, Inc. Dave X. Clarin,* host, leading and only man. Please remind friends and husbands to make Banquet Table Reservations.

Evening Free.

### Wednesday, August 1

**12:15 p.m.**

Luncheon - Annual Picnic - Prizes and Surprises. Buses will leave Delaware Avenue Door, Hotel Statler, for trip to Automobile Club, Clarence, N. Y.

**11:00 a.m.**

EMPIRE STATE ROOM

Technical Session for the Ladies — *Dr. R. B. Saltonstall,* The Udylite Corp., will divulge a number of Platers' Secrets — For Ladies Only.

### Thursday, August 2

**12:15 p.m.**

NIAGARA ROOM

Luncheon for the Ladies, Sponsored by the *Udylite Corp.* Professor Saltonstall will be our host.

**7:00 p.m.**

GRAND BALLROOM

Annual Banquet — Good Food — Good Music — Dancing. Drawing for *Hanson-Van Winkle-Munning Co.* Gifts.

### Gifts for the Ladies

You will find tickets in your registration book.

Souvenir — *Detroit Chemical Specialties Co.,* Detroit, Mich.

Souvenir — *J. J. Siefen Co.,* Detroit, Mich.

Souvenir — *Wyandotte Chemicals Corp.,* Wyandotte, Mich.

Playing Cards—The traditional gift of *Green Electric Co.,* New York.

Barcalounger—Donated by The Barcalo Mfg. Co., 225 Louisiana Street, Buffalo, N. Y.

Dave X. Clarin
*(Aunt Ella)*

Joan T. Wiarda
*Program Co-Chairman*

Dr. R. B. Saltonstall
*Ladies Tech. Chairman*

# International Fellowship Club

AGAIN this year the social aspect of the Annual A.E.S. Convention will be highlighted by the several affairs sponsored by the International Fellowship Club. The generous support of the metal finishing industry's manufacturers and distributors will be in special evidence at the Open House Party and the annual I.F.C. Golf Tournament, but their support of A.E.S. activities in many unseen ways helps make every annual convention a success.

The Annual I.F.C. Luncheon, *for manufacturers and supply house representatives only*, will be held at 12:15 on Monday, July 30th. The primary purpose of this meeting is to get acquainted with competitors in a friendly and informal manner, but a number of important topics will also be brought up. All firms are requested to have a representative present for this meeting.

George L. Nankervis
*President*

On Monday night the I.F.C. plays host to all convention registrants at the Open House Party. Refreshments, dancing, and generous awards will be featured.

On Wednesday morning the I.F.C. will sponsor the annual Golf Tournament, always a high spot for the industry's turf-spoilers. This year's affair will be held at the Orchard Park Country Club, Orchard Park, N. Y. All those planning to play should remember to bring their own equipment. Play will be on a handicap basis, so that the "duffers" and "pros" have an equal chance. The beautiful I.F.C. Golf Trophy goes to the winner of this event. Last year's winner was *Walt Cebulskis* of United Chromium, with second place going to a lady, *Mrs. C. W. Gore.*

As a matter of fact, two of the first five prizes went to the fair sex last year. If the boys don't sharpen up those shots and fly right it might be necessary to include the Golf Tournament in the Ladies Program in future years.

Hackers can be assured an even chance at the beautiful trophy by remembering that the lowest gross score turned in last year for the first four place winners was a snappy 113, with a high of 127. So bring your clubs and golf shoes and keep in there swinging!

These Fellowship Club affairs offer an excellent chance to meet your competitors and talk over mutual problems affecting the entire industry.

## OFFICERS OF THE INTERNATIONAL FELLOWSHIP CLUB

A. P. Munning
*1st Vice-Pres.*

Al Braun
*2nd Vice-Pres.*

Chas. Berry
*3rd Vice-Pres.*

Tom Trumbour
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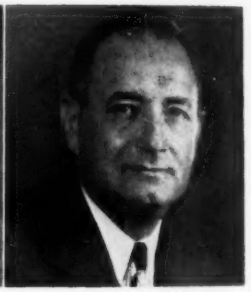


Rudy Hazucha
*Past Pres.*

Al Clem
*Golf Chairman*

International Fellowship
Annual Golf Trophy

# ABSTRACTS OF TECHNICAL PAPERS

George W. Jernstedt
*Chairman, Monday Afternoon Session*

## MONDAY A.M.

### Electrodeposition Researches at the National Bureau of Standards

**By Dr. Wm. Blum**
*National Bureau of Standards, Washington, D. C.*

An informal review of the electroplating researches at the National Bureau of Standards since 1913, including current researches and specific illustrations of results and their relation to the electroplating industry.

## MONDAY P.M.

### Rinsing for Electroplating

**By R. J. Rominski & F. L. Clifton**
*General Motors Research*

Need for more study and control of rinsing; available types of rinses and advantages of each; effect of harmful water impurities and methods for their removal. Importance of proper rinsing.

### Methods of Heating and Temperature Control of Plating Solutions

**By W. E. Stadel and C. Civan**
*George L. Nankervis Co., Detroit, Mich.*

Choice between internal heating coils and external heat exchangers; factors in the design of heat exchangers, including selection of materials; types of temperature-control means and their applications.

### Advantages of Simplicity in the Electroplating of Automobile Bumpers

**By Donald H. Schantz**
*Michigan Bumper Corp., Grand Rapids, Mich.*

Detailed description of a plating sequence in commercial use for finishing automobile bumpers without the use of copper and cyanides; advantages — extreme simplicity, low cost, excellent adhesion of deposit; replating of chromium rejects without buffing; use of alternating current for electrocleaning.

Dr. R. B. Saltonstall
*Chairman, Tuesday Morning Session*

### Practical Application of Diaphragm Tanks in the Electroplating Industry

**By Ezra A. Blount**
*Products Finishing Magazine*

Description of the three general types of diaphragm-tank installations,

Dr. Walter R. Meyer
*Chairman, Tuesday Afternoon Session*

John M. Acheson
*Chairman, Wednesday Morning Session*

Guy M. Cole
*Chairman, Thursday Morning Session*

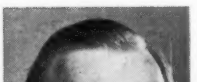
Dr. Wm. Blum

R. J. Rominski

F. L. Clifton

W. E. Stadel

C. Civan



Donald H. Schantz

Ezra A. Blount

G. J. Beckwith

Maurice R. Caldwell

Earl W. Arnold

used primarily for high-speed copper and bright-nickel solutions, and their engineering features; listing of necessary accessory equipment; survey of diaphragm materials; showing of how the plater with a 5-gal. tank may enjoy the advantages of the equipment just as easily as the plater with a 50,000-gal. tank.

## TUESDAY A.M.

### Requirements of Die Casting for Plating

**By Glenwood J. Beckwith**

*Metallon Products, Inc., Los Angeles, Calif.*

Design of articles for efficient polishing and plating; design of dies for high output and good surface characteristics; types of die-casting machines and their operation; composition of die-casting alloys and its effects.

### Mechanical Finishing of Zinc Base Die Castings Prior to Plating

**By Maurice R. Caldwell**

*Jarvis Division, Doehler-Jarvis Corp., Grand Rapids, Mich.*

Reasons for having to polish and buff die castings prior to plating, including information about density and thickness of the "skin" of normal castings; methods of preparation of the surface demonstrated by slides, with explanations of how the equipment is operated and comparisons of the method.

### Chemical and Electrochemical Preparation of Die Castings for Electroplating

**By Earl W. Arnold**

*L. H. Butcher Co., Los Angeles, Calif.*

Adhesion and appearance of electroplated coatings depends on removal of objectionable films without formation of harmful reaction products; precleaning in organic solvents, emulsion cleaners, alkaline soak cleaners; electrolytic cleaning and its control; types and choice of acid dips.

### Electroplating Zinc Base Die Castings

**By Chester G. Borlet**

*United Chromium, Inc., Detroit, Mich.*

Factors affecting electrodeposition as they pertain to successful operation of any plating system employed in the finishing of zinc-base die castings to a well-defined set of specifications; composition, current density, filtration, agitation.

## TUESDAY P.M.

### OPEN FORUM ON SUBSTITUTE FINISHES FOR ELECTRO-PLATING

#### Phosphate Coatings

**By Alfred Douty**

*American Chemical Paint Co., Ambler, Pa.*

#### Chromate Treatment

**By Charles W. Ostrander**

*Allied Research Products, Inc., Baltimore, Md.*

#### Black Oxide Coatings

**By Dr. Walter R. Meyer**

*Enthone, Inc., New Haven, Conn.*

#### Clear and Pigmented Organic Coatings

**By Donald W. Meserve**

*Organic Coatings Div., United Chromium, Inc.*

#### Rust Preventive Oils and Waxes

**By A. W. Ackerman**

*F. E. Anderson Oil Co.*

These short introductory talks will list available processes and materials, and will classify them according to their applicability as substitutes for electroplating processes on civilian goods. Tabular data will be distributed to the audience.

## WEDNESDAY A.M.

### The Evaluation of Quality of Electrodeposits

**By Carl Durkin**

*Chrysler Corp., Detroit, Mich.*

A discussion of some of the properties of an electrodeposited coating which contributes to its quality; laboratory methods of evaluation of these properties for nickel-chromium coat-

Chester G. Borlet

Alfred Douty

ing, including rapid tests that can be used in the production plating shop; presentation of limited data showing correlation with results of atmospheric exposure.

### Operating Control for Optimum Plating Characteristics

**By R. O. Hull and J. B. Winters**
*R. O. Hull & Co., Rocky River, O.*

Principles and practice of the technique of controlling plating baths for uniform deposit quality and continuous production; plating bath standards, and analytical and physical controls for each type of bath with time cycles for keeping the baths within prescribed limits for good operation; the daily "foreman check" for anticipation of trouble before it can interfere with production; differences between plants with continuous production and job or contract shops with variable production with respect to types of baths and control methods.

### Some Practical Considerations of Current Distribution

**Dr. R. A. Schaefer and Harry Pochapsky**
*Cleveland Graphite Bronze Co., Cleveland, O.*

The importance of minimum and maximum thickness and the spread between the two; improvement of quality by application of known concepts of current distribution, some of which are not recognized as having a bearing on the problem, especially when metal distribution is a secondary factor; effect of organic and inorganic addition agents on the physical, chemical and electrical factors which make up "throwing power."

### Nickel Plating with Insoluble Anodes

**By Dr. W. A. Wesley, Dr. D. S. Carr and E. J. Roehl**
*The International Nickel Co., Bayonne, N. J.*

Advantages of an insoluble anode process for nickel plating of metal strip and wire, rolls and inside of tubes and for nickel electroforming of screens; an electrolytic regenerating process for replenishing, cheaply and with good control, the nickel content of a chloride-free nickel plating solution, in which the electrolyte is circulated continuously through the plating cell, a regenerating cell and a filter; characteristics of the process, which makes use of periodic reversal of the current in the regenerating cell; the mechanism which makes this effective.

Chas. W. Ostrander

Donald W. Meserve

## THURSDAY A.M.

### A New Degreasing Evaluation Test — The Atomizer Test

**By Dr. Henry B. Linford**
*Columbia University, New York City*

Dependence on the receding contact angle of currently used degreasing-evaluation tests, namely, the common water-break test and *Springs* spray-pattern test, which allows quantitative estimations of waterbreak; bridging of small oily and greasy areas in the common water-break test, in which the panel is flooded with an excess of water; absence of these limitations in a newly developed atomizer test in which water is sprayed against a previously dyed panel; higher sensitivity of the new test, in which clean areas show a continuous film of water, heavily soiled areas show very fine droplets of water, and lightly soiled areas show large water droplets, than of the spray-pattern (water-break), the fluorescent-dye, the copper-replacement or the ferrocyanide tests, as shown by extensive testing.

### How the Plating Industry Will Benefit from Research on Metal Cleaning

**By Dr. E. T. Candee**
*Lea Mfg. Co., Waterbury, Conn.*

Abstract nature of much research work, making it difficult for management to justify the expense; detailed discussion of how A.E.S. Project No. 12 was laid out and is being conducted; benefits that will accrue to the industry.

### Highlights of the A.E.S. Research Program

**By Dr. Donald Price**
*Oakite Products, Inc., New York City*

Summary of the progress and accomplishments of the past year.

A. W. Ackerman

Carl Durbin

R. O. Hull

J. B. Winters

Dr. R. A. Schaefer

Dr. W. A. Wesley

Dr. Henry B. Linford

E. J. Roehl

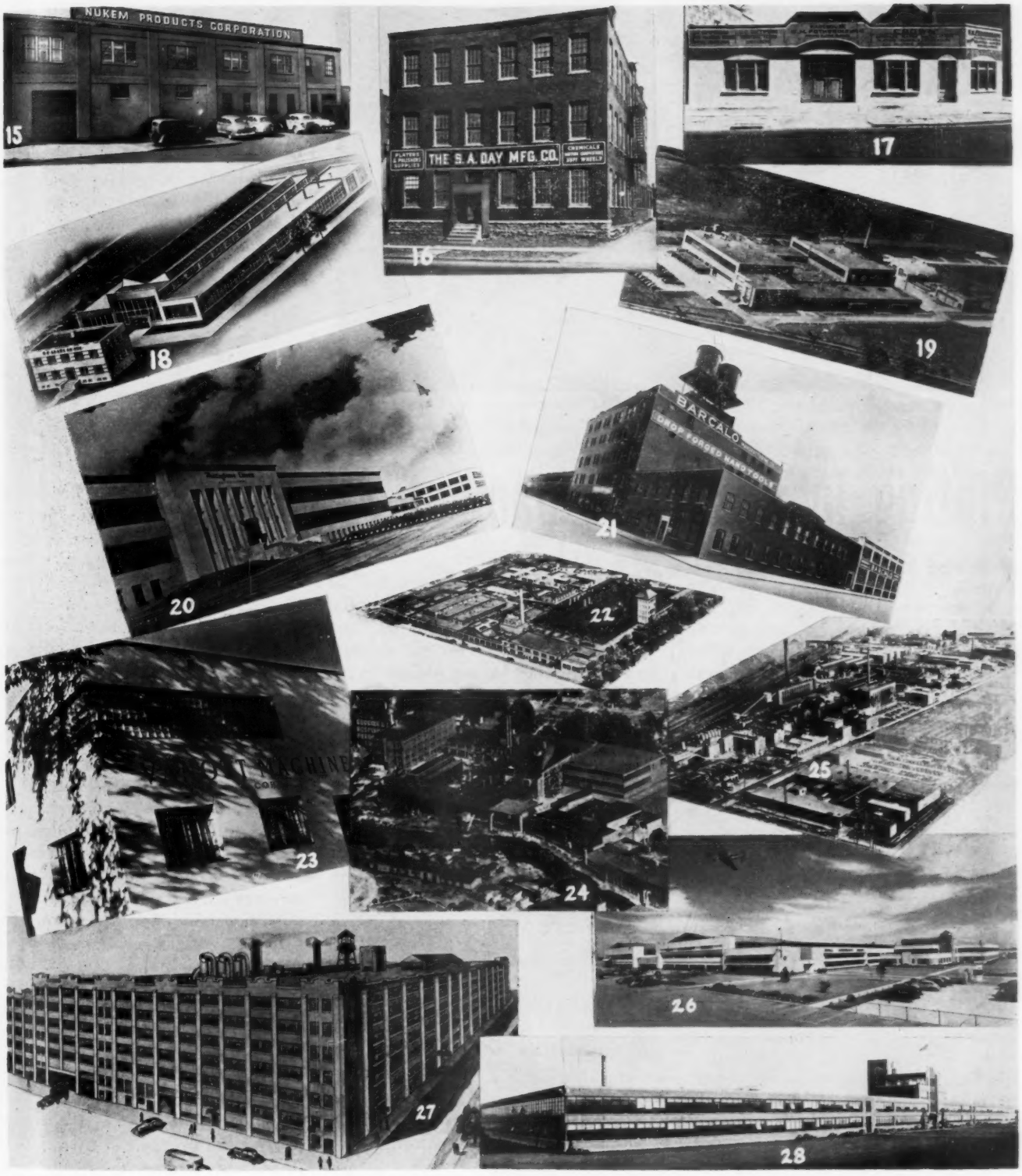
Dr. E. T. Candee

Dr. Donald Price

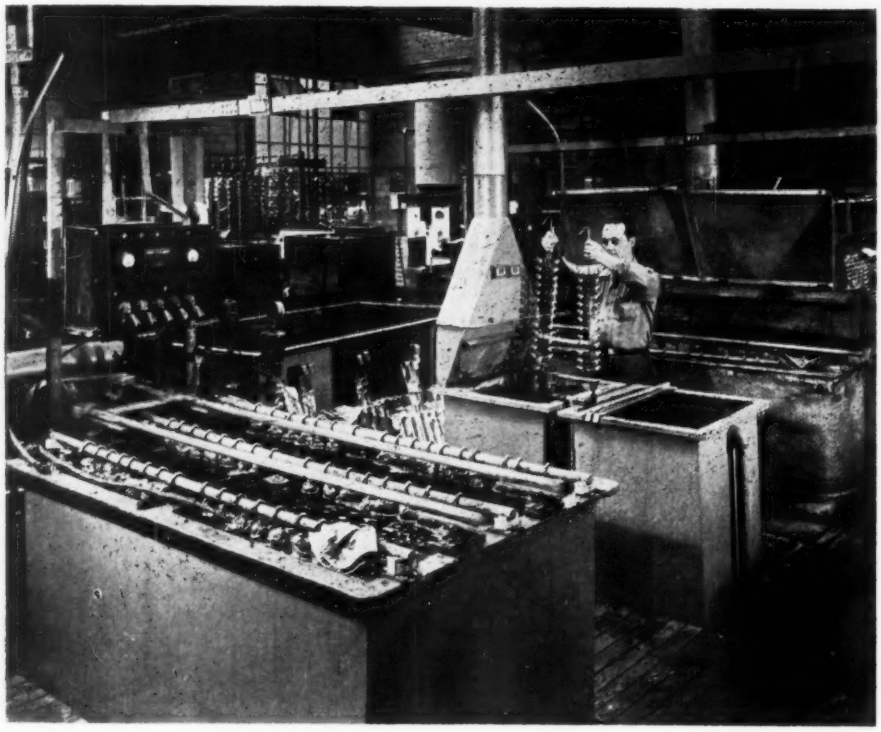
# Some Views of Important Meta Fin

1) Chautauqua Plating Company, Falconer. 2) Sterling Silver Plating Works, Buffalo. 3) Bush Brothers, Olean. 4) Atlas Electroplating Company, Buffalo. 5) Utility Platers, Inc., Buffalo. 6) Tripp Plating Works, Inc., Buffalo. 7) Marlette Plating Company, Buffalo. 8) Jamestown Electroplating Works, Inc., Jamestown. 9) Keystone Chromium Corp., Buffalo. 10. Star Plating Works, Buffalo. 11) Buffalo Plating Company, Buffalo. 12) National Finishing Corp., Buffalo. 13) Vick Plating Company, Buffalo. 14) Speed Plating Works, Buffalo.

# Finishing Plants in Buffalo Area




15) Nukem Products Corp., Buffalo. 16) S. A. Day Mfg. Company, Buffalo. 17) W. M. Fotheringham, Buffalo. 18) R. P. Adams Company, Inc., Buffalo. 19) The Exolon Company, Tonawanda. 20) Westinghouse Electric Corp., Buffalo. 21) Barcalo Mfg. Company, Buffalo. 22) Sylvania Electric Products, Inc., Buffalo. 23) Vanott Machine Corp., Buffalo. 24) Plomb Tool Company, Inc., Jamestown. 25) Hooker Electrochemical Company, Niagara Falls. 26) Bell Aircraft Corp., Niagara Falls. 27) Trico Products Corp., Buffalo. 28) American Optical Company, Buffalo.



America's plating shops are an important factor in armament production.

*(Photo courtesy American Optical Co., Buffalo)*

# Plating in the Re-Armament Program

By Seymour Senderoff, *National Bureau of Standards, Washington, D. C.*

NORMAL peace-time plating has three major functions: 1) decoration, 2) corrosion protection, and 3) to provide surfaces with particular physical and chemical properties required by engineering considerations (frequently referred to as industrial plating). In addition, closely allied with electroplating is the electroforming activities represented in peace-time by printing plates, band instruments, and other metal products in which a metal part is formed entirely of electrodeposited material.

With our nation once more engaged in re-arming for defense, one can be certain that plating for the sole purpose of decoration will continue only so far as material for it can be spared. This will not be very far for such metals as copper and nickel.

To replace this important peace-time branch of plating, we can expect a large increase in plating of the last two types, i.e. plating for corrosion protection and for industrial applications, on armaments and related materials, as well as on the reduced, though still large, amount of non-military articles required for the satisfactory functioning of our society.

Before completely disposing of decorative plating, one should call attention to the fact that there is a military application of plating which is related to decorative plating, though the relationship might be said to be an inverse one. While on a decoratively plated part we hope the plating will draw attention to the article and will distinguish it from its surroundings, on many military items a finish which will do the reverse is highly desirable. For this purpose a number of black and olive-drab conversion coatings were developed and used during the last war. On zinc or zinc-plated parts they are produced by electrochemical or chemical treatment in chromate solutions. In addition to imparting the desired "un-decorative" finish to the article, they also improve corrosion resistance. These finishes were used on many articles, ranging from cartridge cases to airplane propellers. Dyed anodized coatings on aluminum also served the same purpose, and oxidized steel finishes were used where corrosion protection was not required. Even closer to the function of decoration is the use of dyed anodized aluminum for identification purposes on many small aluminum parts.

Passing to the function of corrosion protection we enter a field which is of major importance in military applications equipment. Ship fittings, parts for vehicles and aircraft, and innumerable other items are required for use in every conceivable climate and under conditions and use which are necessarily severe. Large amounts of zinc plating and as much cadmium plating as can be done with the available supply of metal are required on a wide variety of items. In addition, the chromate conversion coatings are specified on many of them. The use of phosphate conversion coatings and anodized aluminum as paint bases are also required to meet the problem of corrosion. Improvements in the conversion coatings on magnesium made in recent years will undoubtedly also find extensive application. Since corrosion is only retarded, not prevented, it provides a fruitful field for the development of

new coatings, new electroplated alloys, and new methods both for general and specific applications to further retard corrosive attack. As an example, particularly good corrosion-resistant properties have been reported by British investigators for tin-zinc alloy plates. The deposition of lead or lead alloys must be given serious consideration, since their protective value is quite high when properly applied, and lead is somewhat more available than other metals now used for the purpose.

With the development of gas turbines and jet engines an entirely new corrosion problem has been introduced and not yet satisfactorily met. Materials which will withstand corrosive atmospheres at extremely high temperatures and gas velocities are required. Present information points to the use of high alloy steels or even parts made from alloys of chromium, molybdenum, or tungsten, with iron as a minor constituent. Since these represent extremely critical materials, the development of processes for plating impervious coatings of such alloys on steel would meet a great need both in corrosion-resistant coatings and in the conservation of critical materials. Another line of approach to this problem is the possibility of electrochemically depositing a layer of refractory oxide. While these oxides are non-conductors when anhydrous, they might be depositable in a hydrated porous state and dehydrated after deposition has been completed. While the author knows of no successful deposition of thick coatings of this type, they could, if developed, be very useful in this application.

This leads to an important fact to which insufficient attention has been given. The very shortages which bedevil the plater and prevent him from doing his normal work open up new fields, in some cases, for plating. During the last war the increased use of electrolytic zinc and tin plate, at the expense of hot-dipped coatings, was the direct result of the greater economy in metal possible with the electrolytic coatings. Chemical processing equipment, pumps, corrosion-resistant piping, and similar items which are normally made of corrosion-resistant alloys can frequently be manufactured by plating nickel and/or chromium on steel in order to conserve the critical alloying materials. In general, where the most important properties of an alloy are its surface properties, critical materials can be saved and satisfactory service obtained by plating a corrosion-resistant metal or alloy on an ordinary base, provided that the plate can be made impervious with a reasonable thickness. It should be noted that there is almost two-and-a-half times as much nickel in a 0.030″ sheet of 18-8 stainless steel as there is in an 0.030″ sheet of carbon steel plated on one side with 0.001″ of nickel!

An important saving of metal is accomplished by plating on plastics where this procedure is applicable. Buttons for uniforms, emblems, dials, and similar articles have been thus manufactured and it is probable that many electrical parts and other items can be prepared in this way when the need arises. Any part whose service is such that a comparatively low level of adhesion by the plate will not be harmful to its operation, and in which the surface properties of the part are important, may advantageously be made from plastic and plated.

It is in the industrial applications that plating proves particularly vital in armament manufacture. The innumerable uses of hard chromium plating on shafts, cams, dies, molds, and other items where a hard, wear-resistant surface is required are well-known. An extreme case of such an application is the chromium plating of the rifled bore of large-caliber gun barrels. As will be seen in the article on hard chromium plating which appears in this series, special techniques in preparation and racking of work, and particularly good solution control are necessary in plating of this type. This is true of industrial plating in general, since the deposion of satisfactory heavy coatings requires extremely good quality of adhesion, smoothness, and uniformity of plate. During the last war, porous chromium plating attained fairly wide use in internal combustion engines and will probably be expanded further. This surface has proven especially effective on piston rings, diesel cylinder liners, and on aircraft cylinders.

Another military application of industrial plating is the wide use of elec-

Scene in the plating department of the American Optical Co., Buffalo, N. Y., one of the many modern finishing shops in this area.

trodeposited bearings for aircraft. Here again very close specifications both as to dimensions and properties of the coatings had to be met. Typical of these were the lead-indium and silver bearings produced in large numbers. These, and bearings made from more recently developed electrodeposited alloys, will be of importance in aircraft engines and in other internal combustion engines.

Plating as a "putting-on" tool has been welcomed by many engineers in salvaging worn or under-machined parts. Worn or undersize rolls, shafts, hydraulic parts, etc., have been built up to their proper dimensions by plating with chromium, nickel, or iron, thereby saving tons of critical metals. While in this country chromium has been the favored material for this purpose, much nickel and iron have been used in England with good results. Electropolishing (or as some prefer, electrobuffing) as a "taking-off" tool has more recently had some interesting applications. Where an inside diameter must be enlarged, especially preparatory to subsequent plating, it is frequently advantageous to take off the metal by electropolishing, which provides at the same time an ideal surface for plating. By proper adjustment of the cathode dimensions and position, one may even taper an inside diameter in a regular, reproducible, and controlled manner. Where inside machining on long, narrow, tubular pieces is required, the efficacy of electropolishing as an alternative procedure should be considered.

There are a few very important applications of industrial plating in which the electroplate doesn't appear on the finished product. Parts such as cylinder sleeves and steel cartridge cases which require deep drawing are frequently copper plated, the copper acting as a die lubricant. Parts such as gears, shafts, and drill-bits, that require selective case-hardening by nitriding, are frequently copper plated, the copper in this case acting as a stop-off for the hardening bath. The sections to be hardened may either be stopped off with lacquer and the rest of the piece copper plated, or the entire piece may be plated and final machining then performed on the sections to be hardeend. The copper is removed from the appropriate areas during this final machining.

Electrical requirements provide a large demand for plating of many types. Silver or gold plating of electrical contacts is frequently necessary, especially when the parts are used in corrosive atmospheres. Under severely abrasive or erosive conditions resort is frequently had to chromium plating in spite of the somewhat higher resistance of chromium contacts. Copper plating is frequently done on electrical or electronic components made of aluminum, germanium, or other metals which are difficult to solder, to provide a surface suitable for soldering connections. Since very high frequency currents are carried only in a thin skin around the conductor, copper or silver plate may be deposited on a less-conductive material having the advantage of either greater strength or lower weight, and the currents effectively transmitted in the high conduction skin. A particularly interesting application of plating to electronic equipment was the manufacture of antenna masts by the electrodeposition of copper on wood.

One of the most fruitful fields for new contributions of electroplating to the defense program is in electroforming. Where a part is required that must be manufactured with exceptionally high precision, that is not too large, and especially one containing thin structural members, or small irregular, precisely reproduced surface variations, electroforming may be the most economical, if not the only practical way of making the part. The computing cam electroformed with iron is a good example of this type of work produced in the past. Military searchlight and beacon reflectors up to fairly large sizes have been electroformed with copper and plated with rhodium with exceptionally fine results both with regard to the finish and the accuracy of dimensions. Recently, extremely accurate waveguides for microwave and radar applications have been electroformed with copper, silver, and other metals (see Figure 1). This work requires very fine plating technique, a high level of ingenuity in design of mandrels, racks and guards, and frequently highly individualized procedures for starting the plating and separating the completed part from its core or mandrel. The electroformed wave guides have been produced with a uniformity of dimensions, sharpness of angles, and accuracy of bends, that are not obtainable by any reasonable mechanical procedure.

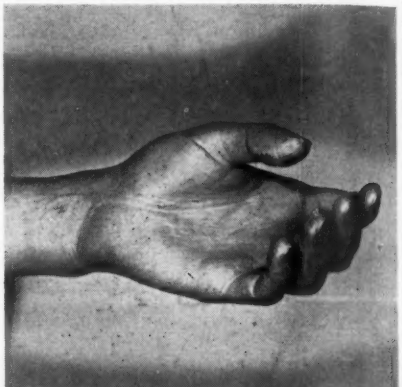


**Figure 2. Electroformed metal mold for cosmetic gloves. The inside surface is used in making the gloves.**

Another triumph of electroforming is the manufacture of fine wire screen from a number of metals. The screen produced is a flat grid. There is no intertwining of wires at the intersections, and extremely fine meshes have been produced with great precision and uniformity. One method of producing these screens uses a glass starting sheet in which the grid of desired dimensions is engraved. A conducting film is then applied to the entire surface, the film wiped off so that it remains only in the engraved lines, and the plating is then

(*Continued on page* 114)

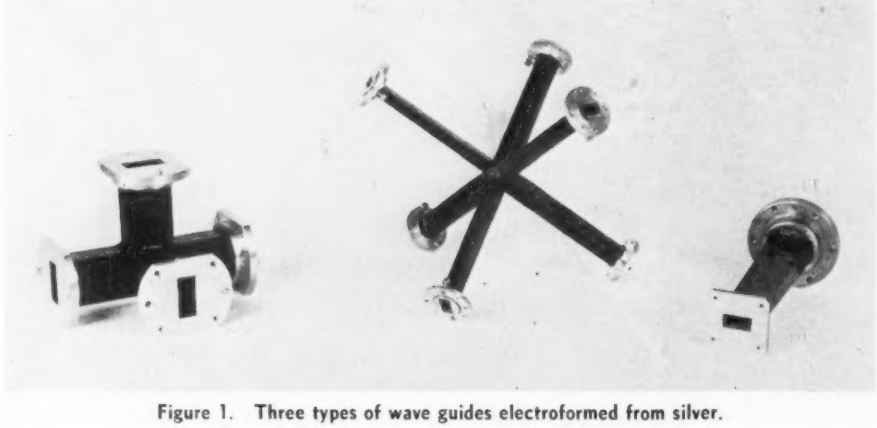


**Figure 1. Three types of wave guides electroformed from silver.**

*Official U. S. Army photograph*

# Finishing Army Ordnance Materiel

By G. T. Viglione, *Materials Engineer — Office, Chief of Ordnance*

METAL finishing, or the art of modifying the surface of a metal to make it efficient in its intended application, is of vital concern as applied to Ordnance materiel. The type of finish which is specified for a given component is influenced by a large number of factors, the most important of which are (1) the function of the part, (2) the metal of which it is made, and (3) the conditions under which it is expected to operate. To the designer of Ordnance materiel, it is of importance to study these basic factors and be cognizant of the purpose, properties and efficiency of a specific finish. The following data represents a study of the measures being taken to prevent corrosion difficulties encountered on Ordnance materiel and is a survey of the finishes available to Ordnance Engineers to alleviate operational difficulties due to corrosion.

Coatings or finishes are applied to Ordnance materiel for one or a combination of the following reasons: corrosion, abrasion, wear and erosion resistance; coloring for camouflage; building up worn or mismachined parts.

By far the most important of these factors is corrosion resistance. Steel, which accounts for the greatest tonnage of Ordnance materiel, is in greater need of protection than most other useful alloys because of its great tendency to rust.

### *Types of Finishes Used*

#### Phosphate Finishing

The finish which is most generally used on steel components is the phosphate type of coating. This coating has been found to give satisfactory service, when painted or coated with oil or grease, while in service. Structural components such as exterior surfaces of vehicles, artillery mounts and field carriages are almost always phosphated. Another type of phosphate finish is also frequently used on gear trains, elevating mechanisms and other mechanical frictional components with a supplemental oil dip.

As will be noted, the type of phosphate coating applied to a component varies with the specific intended use of a part, i.e., structural and/or mechanical. Occasionally one component will be used for a combination of purposes in which case one standard finish is used for both types of surfaces and the component is oiled, greased or painted as required when completed. The photograph (Figure 1) illustrates several components of this type, phosphated during a regular overhaul job.

The overhaul processing follows a routine pattern, utilizing conventional grease, oil and paint removal solutions. A heavy duty slushing operation is used when the work is received in the shop. This slush consists of an ordinary solvent soak at room temperature to effect removal of grease and oil. After this initial step, components are separated for further degreasing, using a vapor type degreaser or alkaline stripper for loosening paint, and all of the components are subsequently vapor blasted or sand blasted as required. Upon completion of the blasting operation, components are rinsed in a light alkaline cleaner, rinsed in hot then cold running water and finally transferred to the phosphating tank. The photograph (Figure 2) illustrates some of the racking-up methods used in one of the midwest ordnance plants and portrays the line of phosphating tanks with the necessary hoists to carry heavy components.

In addition to overhaul phosphating, there are a wide number of new parts that receive phosphate treatment in the course of their manufacture. One such item is the machine gun belt link shown in Figure 3.

This link, when loaded with ammunition, forms a belt which is fed to an automatic machine gun. The link is made of carbon steel and formed on a punch press in great quantities.

The first step of the final finishing is a burr removal process accomplished by tumbling links with emery. The emery used is of the aluminum oxide type and the deburring or tumbling operation is a semi-automatic one consisting of the following:

Figure 1. Tray of typical parts for phosphating during overhaul process.

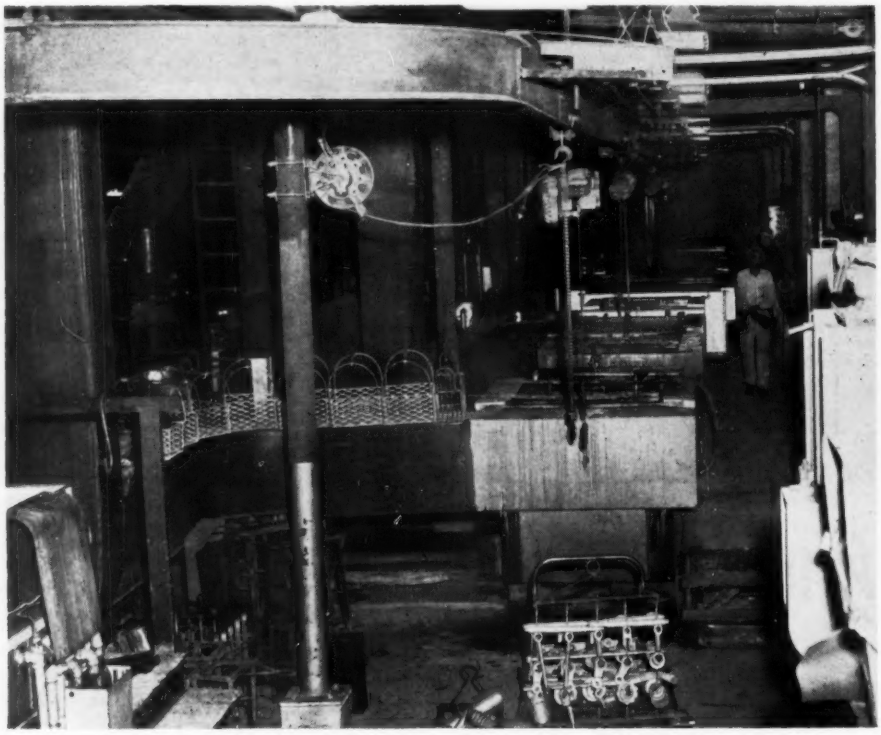


Figure 2. Overhaul phosphating installation at a Midwestern Ordnance plant.

A series of four horizontal tumbling barrels (see Figure 4) are arranged end to end and connected by a screw conveyor section which transfers the links during the processing from barrel to barrel.

The first barrel tumbles the links in a mixture of emery and water to remove burrs. From here the links pass into a rinse barrel charged with a clear, hot water.

From the rinse barrel the links are discharged into the phosphating barrel, which is made up of a stainless shell with an internal screw for moving the links and a series of scoops and drains for picking up the solution from the tank beneath the barrel and discharging excess solution back into the tank. This process maintains the strength and temperature of the solution inside the barrel and moves the links so that an even coating is built up on all of the link surfaces. With the barrel set to rotate at $\frac{2}{3}$ rpm, the time required for a link to traverse the phosphating barrel is thirty minutes, with the solution strength held at a point where a phosphate coating is formed of sufficient thickness to meet the specified salt spray requirements.

From the phosphating barrel the links pass automatically through a water rinse, chromic acid rinse, a forced hot air drying section, and an oil dip.

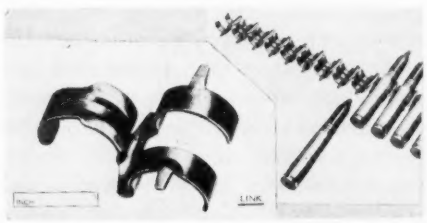


Figure 3. Cartridge clips, one of the many production phosphating items in Ordnance work.

## Cadmium and Zinc Plating

The application of cadmium or zinc to Ordnance materiel is primarily to resist corrosion, rather than improve appearance. The majority of the applications also serve as an undercoating for paint.

A typical example is the zinc plating and subsequent painting of steel cartridge cases. Previous to World War II, all cartridge cases were manufactured from high grade brass, because of the excellent drawing properties of material. However, the development of more efficient forming methods plus better steel compositions resulted in the successful manufacture of steel cartridge cases, (Figure 5). Since steel tends to corrode very rapidly under exposure to the elements, the absence of a protective coating would cause automatic high speed guns to jam during firing. To overcome this zinc plate is usually applied as a base coat to cartridge cases of this type.

Plating is performed in barrels of the conventional hoist-type, operating in zinc cyanide baths. The barrelling operation takes approximately twenty minutes to secure the deposit required by specifications. A chromate dip provides a conversion coating which further increases corrosion resistance. This involves a twenty second immersion in a solution of sodium dichromate and sulphuric acid dissolved in water. The chromated cartridge cases

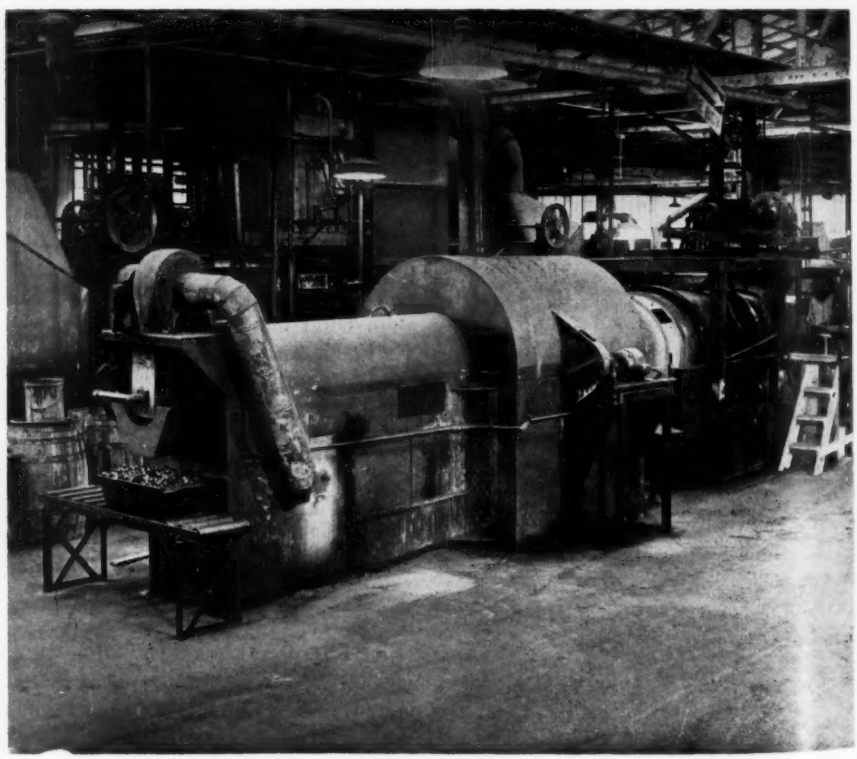


Figure 4. High production barrel phosphating line for cartridge clips.

are then coated with phenol-formaldehyde varnish to complete the cycle.

### Hard Chrome Plating

When corrosion, wear, and abrasion-resistant coatings are required chromium plating is extensively used. A typical example of hard chromium plating an Ordnance materiel is its application to the bore of a hydraulic jack cylinder, Figure 6. As in all hydraulic mechanisms, a very smooth operating surface is required to eliminate unnecessary wear of the hydraulic packing. This same surface must also be corrosion resistant and not subject to any galvanic action which may be set up due to acid conditions in the packing material. To eliminate the possibility of corrosion and reduce wear, .0015 - .003″ of chromium is deposited on the operating surface.

When plating new work, the surface condition of the jack cylinder is standard because of the previous standardized machining and grinding operations. Therefore, a very light degreasing operation and reverse etch in the chromic acid solution is all that is required before plating. However, on material which is being rebuilt it is necessary to exercise additional precautions. One of the conditions usually encountered is what is known as a "cold-worked" area. This condition is known to prevent or cause extremely erratic surface sensitivity which will result in an inferior chromium plate. Therefore, it is essential that this type of surface be cleaned up by a finishing operation such as lapping or a light satin finish and buffing operation. This procedure is sufficient to remove any stressed area or surface imperfections in the cylinder wall. Subsequent to this operation, a vapor degrease is utilized to remove any buffing compound from the surface. Racking-up is then performed as shown. A reverse etch of 2-3 minuted at 150 amperes is first initiated and then a direct switch-over to plating conditions.

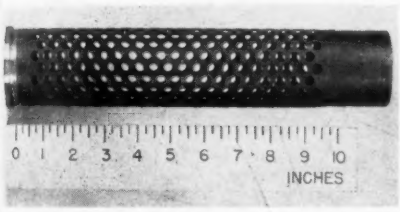



Figure 5. Steel cartridge case, formerly made of brass, is now made of steel and zinc plated in huge quantities.

In view of the construction of the jack cylinder, which is designed with only one end open, it has been found desirable to effect light agitation by forcing fresh solution through the anode to the bottom of the cylinder while plating.

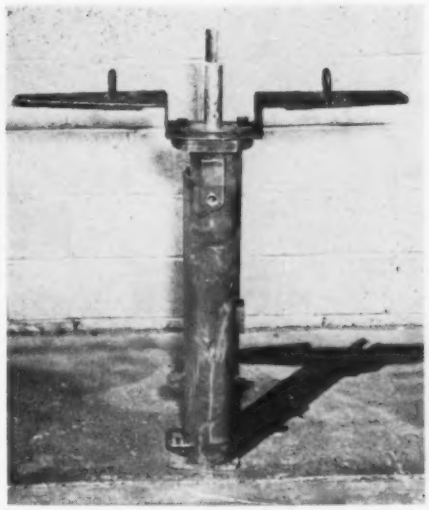


Figure 6. Set-up for hard chrome plating the inside of a hydraulic jack cylinder.

The very fine grain chrome coating, with a minimum of porosity and of the required thickness promotes extended life of the weapon in service.

### High Speed Chromium Plating

High speed chromium plating techniques are used on components where the area to be plated is small enough to handle at the high amperage involved. High-speed hard chromium is applied to the bore and breechblock face of the Recoilless Rifle, among other items. (Figure 7 illustrates bore.)

The drawing calls for a .003″ - .005″ final finish grind thickness of chromium plate. This means that chromium must be applied on the order of .005 - .006″. Furthermore, this deposit must be dense, extremely adherent, hard, and of sufficient ductility to stand impact loading. Of course, the presence of pits, nodules or any other irregularity is not permitted.

Figure 7. Recoilless rifle bores are chrome plated in a high speed process.

In order to attain a deposit of .005″ - .006″ of chromium in the conventional electroplating bath operating at 135°F. and 2 amperes per square inch (or 125 amperes per square foot), approximately 12-16 hours are needed. By carefully observing the following factors: (1) surface finish previous to plating, (2) solution composition, (3) solution temperature, (4) current density, and (5) anode design, peak production of one piece per hour, securing a maximum deposit of .008-.010″ of chromium, can be accomplished.

Inasmuch as SAE 4340 steel is used in this component, it is a simple matter to polish and buff to a high luster the surface on which it is desired to deposit chromium. This reduces irregularities which might otherwise be produced in the final deposit. It is widely known that surface irregularities, when plating at high speeds, cause variations in current density and uneven deposits.

Figure 8. Aluminum dipod for infantry recoilless rifle is anodized and given two coats of paint for maximum field service.

By proper anode design, shading, thinning, etc. the prominent corners of the part to be plated are protected from excessive build-up and burning due to high current density.

During operation of this cycle the temperature of the solution is held between 150° and 153°F., using a current density of 21 amperes per square inch. Under these conditions, a deposit of .0065″ of chromium can be realized in one hour plating time. The deposit is very dense, free of nodules and pits, possessing a hardness of 800-900 Brinell.

It is to be noted that constant filtration is essential in a high speed plating

(*Continued on page* 114)

Born during World War II, the rocket battery employs a new ordnance technique.

# Plating's Role in Naval Ordnance

## The Naval Gun Factory at Anacostia

POLISHING and plating as a separate activity was started at the Naval Gun Factory in Washington in 1898. In 1908 electroplating tanks for nickel, copper and silver were installed in a lean-to on the buffing shop for the purpose of electroplating such items as torpedo details, 1- and 6-pounder gun parts, and the bright work and silverware for the Presidential yachts. Very little ordnance material was electroplated prior to World War I, and the service of only one employee was required to do all the electroplating for the Gun Factory.

In 1923 the electroplating and buffing activities were combined in one building, and designated the Buffing and Plating Shop. At that time additional electroplating processes were installed that enabled the shop to expand its plating activities. A new process of lead-tin alloy plating was developed for torpedo details, and cadmium plating was introduced for rustproofing other ordnance material. This new equipment for these activities included tanks of sufficient size to permit the cadmium plating of gun mounts for 4", 5" and 6" guns. Cadmium plating proved very beneficial in protecting ordnance material from the corrosive action of salt sea water and was adopted as a standard requirement for many parts. The use of cadmium plating saved many thousands of dollars' worth of ordnance material from deterioration due to corrosion. This resulted in such an increase in the demand for electroplating that further expansion of the electroplating facilities was required. Additional space was provided by transferring the polishing and buffing activities to a separate building, allowing space for additional electroplating facilities.

In 1927 funds were made available for the installation of a more modern electroplating plant with particular emphasis being placed on chromium plating, with the idea of chromium plating the bores of major caliber gun barrels. This plant was installed in 1928 and was the first complete electroplating plant established by the Navy. Since then, electroplating plants have been installed in other Naval activities from plans, instructions and specifications furnished by the Naval Gun Factory. With the advent of chromium plating many opportunities developed for increasing the life and usefulness of many ordnance details by electroplating areas where excessive wear occurred. Chromium, being hard, of considerable wear resistance and of some corrosion resistance, gave increased life to parts subjected to wear and a combination of wear and corrosion. Techniques have been developed for salvaging worn and mis-machined parts by electroplating them to restore them to size. Materials valued at many thousands of dollars have been salvaged by this method.

The first gun barrel was chromium plated in 1928 and from tests it was considered of sufficient value to justify the continuance of chromium plating gun barrels. By 1933 specifications required that all major caliber gun barrels from 3" to 16" be chromium plated throughout the bores. This necessitated the installation of additional equipment and the development of special anodes.

### *Finishing Equipment*

The plating equipment in the Naval

*(Published by permission of The Public Information Office, Naval Gun Factory.)*

Gun Factory for plating gun bores consists of: 1 plating pit, 75′ deep; 2 plating pits, 60′ deep; 4 plating tanks and 4 cleaning tanks, 36″ in diameter and ranging from 10′ to 27′ deep; 1 lead plating tank, 18″x18″x26′ long; 1 lead plating tank 30″x30″x36″ deep (the lead plating tanks are used for plating anodes for gun barrels); 4 electrolyte storage tanks ranging in size from 300 gals. to 900 gals.; 2-10,000 - 5,000 ampere, 8-16 volt motor-generators; 4-500 ampere, 6 volt rectifiers; 1-500 ampere, 6 volt motor-generator for lead plating; 1-40 ton and 2-135 ton overhead cranes; buffing equipment for buffing the bores and rifling grooves in all major size gun barrels.

Buffing equipment for gun bores was developed by the Naval Gun Factory. This equipment consists of a mechanical buffing head containing up to 4 buffing wheels so arranged that they revolve parallel to the axis of the gun bore, making it possible to buff the bottoms of the rifling grooves and remove all minor roughness left by the machining and lapping operations.

The electroplating and polishing activities of the Gun Factory are now occupying four separate buildings totaling 35,000 square feet of floor space. One building is used for gun plating, one for polishing and buffing, and two for miscellaneous plating, which is done mainly on material for Naval Ordnance. A considerable amount of plating is done for other Naval activities and departments of the Government. To accomplish this work the following equipment is available:

- 14 Chromium plating tanks ranging in size from 60 gals. to 1,800 gals.
- 6 cadmium plating tanks ranging in size from 400 gals. to 3,000 gals.
- 2 zinc plating tanks: 400 and 600 gals.
- 2 semi-automatic tanks for zinc or cadmium.
- 4 plating barrels: 2 for cadmium, 1 for zinc and 1 for nickel.
- 4 nickel plating tanks ranging in size from 100 gals. to 1,800 gals.
- 1 tin plating tank: 400 gals.
- 1 Lead-Tin alloy plating tank; 400 gals.

Anodizing process tanks for both sulphuric and chromic acid anodizing. 9 tanks from 50 gals. to 300 gals.

Phosphate surface treatment equipment; 4 tanks, 400 gals. each.

Blackening process tanks; 6 tanks 100 gals. ea.

- 3 copper plating tanks; 400 gals. ea.; one acid copper, two alkaline copper.
- 1 silver plating and 1 strike tank; 60 gals. ea.
- 1 gold plating tank.

Equipment for special finishes such as oxidizing, coloring, etching, electropolishing, etc.

- 4 10,000-5,000 ampere, 8-16 volt motor-generator; one is a spare.
- 1 500 ampere, 50 volt motor-generator.
- 1 300-150 ampere, 12-24 volt motor-generator.
- 1 500 ampere, 6 volt motor-generator.
- 1 100 ampere, 25 volt motor-generator.
- 3 vapor degreasers.
- 1 1-ton traveling bridge crane.
- 1 10-ton traveling bridge crane.

There are cleaning, pickling and rinse tanks in sufficient numbers to handle the work done in the above listed equipment.

Many types of racks and anodes have been developed for use in plating ordnance material, some very plain, some rather complex. Some consist of cathode racks and anodes combined in a single unit; others consist of cathode racks, internal anodes and external anodes in a single unit, with separate current control to each anode. This is necessary where close tolerances are required on the thickness of deposits on interior as well as exterior surfaces.

In the Polishing and Buffing section all the grinding, polishing, buffing and sandblasting required for the finishing of metals is done. There are 19 polishing and buffing lathes, 2 cabinet sandblasts; 2 tumbling barrels, 10 grinding booths, polishing wheel maintenance equipment and numerous portable air and electric grinders. These polishing and buffing lathes, sandblasts and grinding booths are all connected through suitable hoods and ducts to a dust exhaust system capable of removing 85,000 cu. ft. of air per minute. Work done in this section falls into three classes: work of a small nature that can be done on the buffing lathes; work too large to be handled at the lathes, but small enough to transport economically to the shop, where it is done with portable grinding, polishing and buffing equipment in booths from which the grinding dust is exhausted; and work on items of such size that transporting them to the shop is prohibitive, in which case it is done at the place of assembly. For this type of work the mechanic goes to the job and performs his work with portable air or electric polishing and buffing equipment. Some of the last two types of work requires hand grinding and polishing to gage tolerances on such items as shell trays, projectile and powder hoists, breech housing, etc. Some of these weigh many thousands of pounds

Figure 1. Chromium plating section of the polishing and plating shop.

and cannot be done economically by other means.

### *Plating Preparation*

The preparation of articles for electroplating is done by the usual methods practiced by the trade. The desired finish is obtained by grinding, polishing, buffing or sandblasting. It is then soaked or electrocleaned in alkaline cleaners, rinsed, acid dipped, double rinsed and plated. In some cases, for cadmium and zinc plating, the work is stored in a cyanide solution after cleaning while awaiting racking. After cadmium and zinc plating the work is double rinsed, dipped in a 1% nitric acid neutralizing solution, rinsed, dipped in hot, weak soap water and dried. This is to prevent tarnish from finger stains while being handled through inspection. Cleaning the larger guns is accomplished by placing the gun in a pit in a vertical position on its breech end on a sealing gasket and filling it with cleaner solution. A steam coil is then inserted in the gun and the cleaner is heated to 190° to 200°F. for about one hour. The solution is then drained from the gun and the bore is scoured with cleaner solution and powdered pumice. It is then rinsed and again scoured with a 10% sulphuric acid solution and powdered pumice, and after a thorough rinse, several gallons of chromic acid are poured through the gun to protect the cleaned surface until the gun is filled with the plating solution. The scouring is done with a special mop which consists of several sections of wire brush wheels mounted on the end of a pipe shaft of sufficient length to reach through the gun. The brush wheel sections are slightly larger than the bore of the gun so that when it is drawn through the gun the wire bristles will press into the bottom of the rifling grooves. The wheel sections are covered with several layers of burlap which is saturated with the cleaner or acid solution and lowered and raised successively through the gun while the solution and powdered pumice are allowed to run down the surface of the gun. The mop, weighing several hundred pounds, is raised and lowered through the gun by an overhead crane.

### *Plating Solutions*

All plating solutions are maintained to standard formulas by weekly chemical analysis and additions. When necessary, due to high production in any solutions, more frequent checks are made. No additions, except water to maintain solution level, are permitted except those indicated by analysis. The chemical analyses of the solutions are made in the chemical laboratory where a chemical engineer and a corps of assistants are assigned to this work, to the analysis of all materials used in the plating baths, and to conducting laboratory research as an aid to solving metal protection and finishing problems.

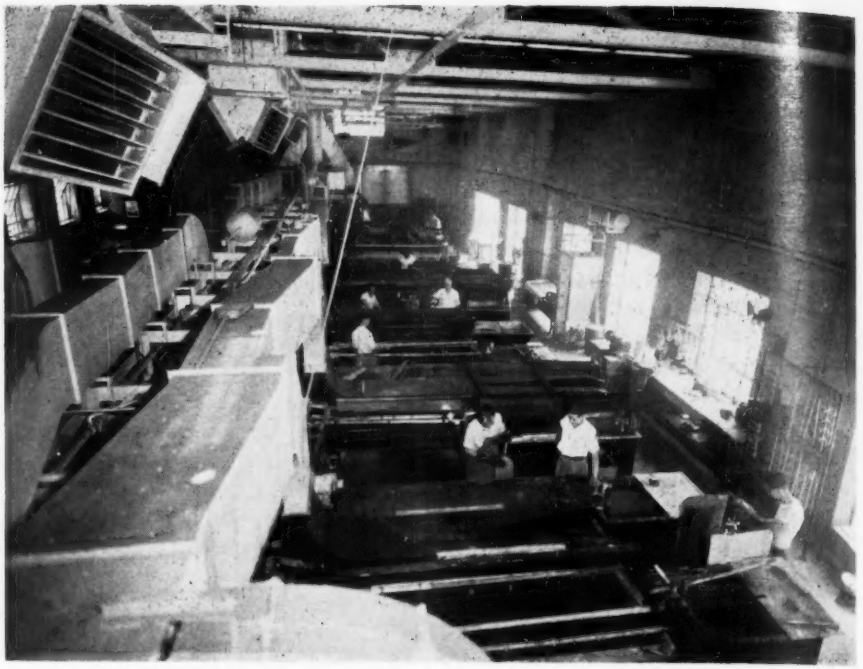


Figure 2. Cadmium and zinc plating section of the polishing and plating shop.

The formulae and operating conditions of the electroplating solutions used at the Naval Gun Factory are as follows:

#### Zinc

| | |
|---|---|
| Zinc Cyanide | 8.0 oz./gal. |
| Sodium Cyanide | 3.0 oz./gal. |
| Sodium Hydroxide | 10 to 12.0 oz./gal. |
| Corn Sugar | 1.0 oz./gal. |
| Temperature | 90° F. |
| Current Density | 15 to 75 amps./sq. ft. |

Purified periodically with zinc dust, agitation and filtration.

Neutralizing dip after plating: 1% Nitric Acid.

Anodes-Zinc, containing small amounts of magnesium or calcium to prevent undue chemical solution of the anode.

Rate of deposition: 0.0008" to 0.003" per hour.

#### Cadmium

| | |
|---|---|
| Cadmium Oxide | 2.3 to 3.4 oz./gal. |
| Total Sodium Cyanide | 9.0 to 10.0 oz./gal. |
| Free Sodium Cyanide | 5.0 to 6.0 oz./gal. |
| Sodium Hydroxide | 0.2 to 1.5 oz./gal. |
| Brightener | As required |
| Current Density | 10 to 15 amps./sq. ft. |
| Temperature | 80° to 90° F. |

Anodes-Cadmium sticks in steel baskets.

Rate of deposition: 0.0008" to 0.0012" per hour.

Neutralizing dip after plating: 1% Nitric Acid.

#### Chromium (Solution A)

| | |
|---|---|
| Chromic Acid | 33.5 to 36.8 oz./gal. |
| Sulphate | 0.335 to 0.368 oz./gal. |
| Current Densities | 150 to 500 amps./sq. ft. |
| Temperatures | 120° to 145° F. |

Rate of deposition: 0.0003" to 0.0015" per hour.

When plating the interior of gun barrels at the higher current densities with Solution A, slightly nodular deposits similar to those obtained from solutions with insufficient sulphate have been encountered. The nodule formation seems to be characteristic of plating in a confined space with violent gas evolution and under these conditions it has been found necessary to increase the sulphate concentration (Solution B).

#### Chromium (Solution B)

| | |
|---|---|
| Chromic Acid | 33.5 to 36.8 oz./gal. |
| Sulphate | 0.40 to 0.42 oz./gal. |

#### Tin

| | |
|---|---|
| Sodium Stannate | 12.0 oz./gal. |
| Caustic Soda | 2.0 to 3.0 oz./gal. |
| Sodium Acetate | 2.0 to 3.0 oz./gal. |
| Hydrogen Peroxide (100 vol.); or | |
| Sodium Perborate | 1/16 oz./gal. |
| Cathode Current Density | 6 to 60 amps./sq. ft. |
| Anode Current Density | 5 to 25 amps./sq. ft. |
| Temperature | 140° to 176° F. |

For satisfactory operations the anode current density is important. It has no

fixed value but varies directly with the temperature of the solution and the free caustic soda and tin content of the bath. When proper balance is obtained the anodes become covered with a greenish yellow film. This condition of operation is critical and will vary with each bath. When the solution is properly maintained and operated, deposition should be at the rate of 0.000057" per ampere hour per sq. ft.

### Immersion Tin for Brass or Copper

| | |
|---|---|
| Stannous Chloride | 0.67 oz./gal. |
| Sodium Hydroxide | 1.69 oz./gal. |
| Sodium Cyanide | 16.0 oz./gal. |
| Temperature | 60° to 90° F. |
| Coating Time: ¼ to 10 minutes | |
| Coating Thickness: 0.00003" to 0.00008" | |

### Lead Fluoborate Solution

| | |
|---|---|
| Basic Lead Carbonate | 20 oz./gal. |
| 50% Hydrofluoric Acid | 32.0 oz./gal. |
| Boric Acid | 14.0 oz./gal. |
| Glue | 0.025 oz./gal. |
| Temperature | 70° to 80° F. |
| Current Densities | 9 to 19 amps./sq. ft. |

### Lead 50% — Tin 50% Alloy

Lead-tin fluoborate solutions are made by electrolyzing at 10 amps. per sq. ft. a standard lead fluoborate solution using pure tin anodes and "dummy" cathodes until the equilibrium solution for depositing the alloy is reached. For depositing a 50% lead 50% tin alloy, the final solution should contain approximately 2.63 oz. per gal. of lead and 6.45 oz. per gal. of tin. Frequent stirring of the solution while electrolyzing is necessary. After electrolyzing, tin anodes and "dummy" cathodes are removed, and the solution filtered if it is not clear.

In operation, it is customary to use lead-tin anodes containing 45% tin-55% lead; current density of 4.7 to 14.0 amps. per sq. ft. at room temperature.

### Copper Cyanide Solution

| | |
|---|---|
| Copper Cyanide | 6.0 oz./gal. |
| Sodium Cyanide | 76. oz./gal. |
| Sodium Carbonate | 2.0 oz./gal. |
| Copper Content | 4.3 oz./gal. |
| Free Syanide | 0.9 to 1.0 oz./gal. |
| Temperature | 100° to 120° F. |
| Current Density | 10 to 20 amps./sq. ft. |
| Rolled Copper Anodes | |

### Acid Copper Solution

| | |
|---|---|
| Copper Sulphate | 27.0 oz./gal. |
| Sulphuric Acid | 6.5 oz./gal. |
| Temperature | 77° to 122° F. |
| Current Density | 19.0 to 37.0 amps./sq. ft. |
| Rolled Copper Anodes | |

### Nickel

| | |
|---|---|
| Nickel Sulphate | 27.0 oz./gal. |
| Nickel Chloride | 6.0 oz./gal. |
| Boric Acid | 4.0 oz./gal. |
| pH-5.3 (Glass Electrode). | |
| Temperatue | 122° to 140° F. |
| Current Density | 14 to 47 amps./sq. ft. |
| Rolled 99 + % Nickel Anodes | |

### Silver (Strike)

| | |
|---|---|
| Metallic Silver | 0.61 troy oz./gal. |
| As Silver Cyanide | 0.79 troy oz./gal. |
| Potassium Cyanide | 9.0 oz./gal. |
| Anodes — Annealed, rolled, | 999 fine silver |
| Temperature | 70° to 80° F. |
| Current Density | 10 to 15 amps/sq. ft. |

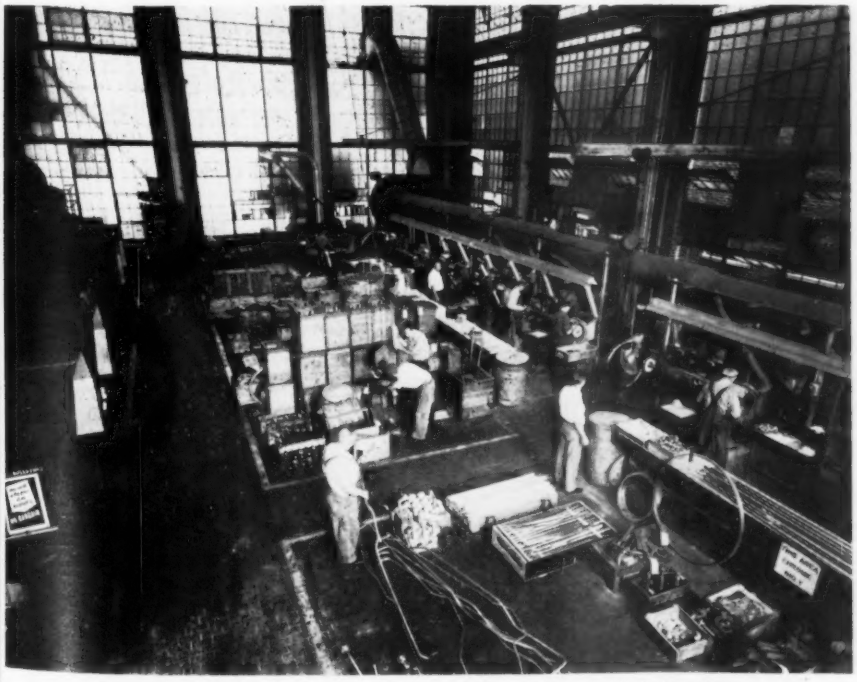


Figure 3. Polishing and buffing section of the polishing and plating shop.

### Silver

| | |
|---|---|
| Metallic Silver | 3.5 troy oz./gal. |
| As Silver Cyanide | 4.4 troy oz./gal. |
| Total Pot. Cyanide | 5.0 oz./gal. |
| Free Pot. Cyanide | 2.5 oz./gal. |
| Potassium Carbonate | 5.0 oz./gal. |
| Anodes — Annealed, rolled, | 999 fine silver |
| Temperature | 70° to 90° F. |
| Current Density | 2.75 to 9.0 amps/sq. ft. |

(C.D. depending on the free cyanide and carbonate content.)

### Gold

| | |
|---|---|
| Metallic Gold as Fulminate | .34 oz./gal. |
| Potassium Cyanide | 2.00 oz./gal. |
| Anodes — 24 Karat Rolled Gold | |
| Temperature | 140° to 176° F. |
| Current Densities | 1.00 to 500 amps/sq. ft. |

The higher current densities are used at the higher temperatures. This solution is used for depositing high purity gold on electrical contacts where the minimum of electrical contact resistance is desired. It has been found that the gold as deposited with a soft matte finish has less contact resistance than when burnished.

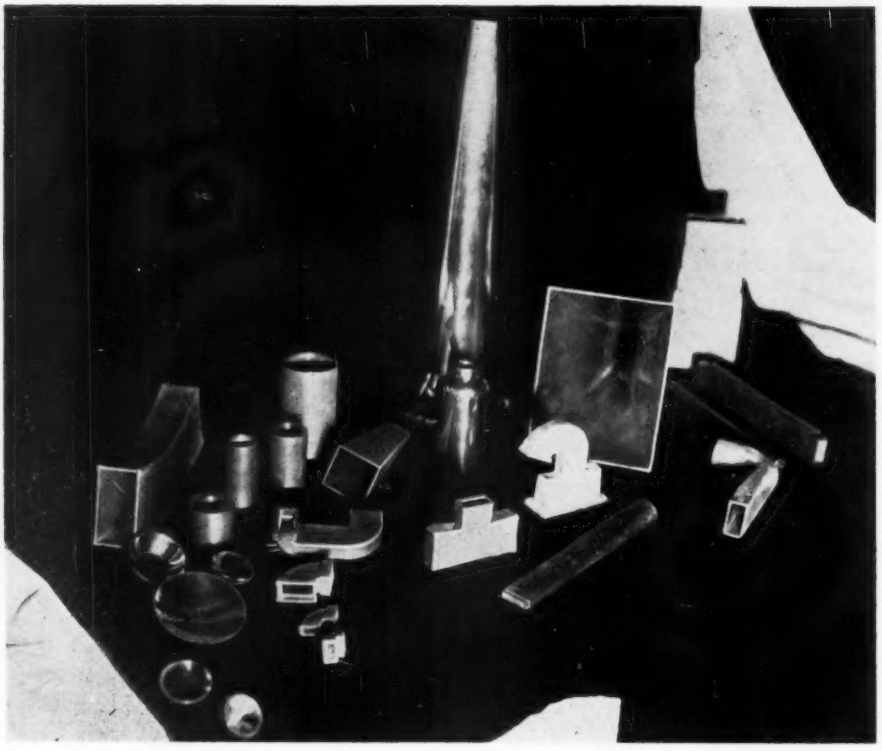
## *Recovery of Cadmium Metal From the Cadmium Strip*

Cadmium is stripped from plating racks and defective products in a solution containing 8 to 16 oz. per gal. of ammonium nitrate. Because of the scarcity of cadmium, the cadmium is salvaged from the strip solution in the following manner:

The strip solution, when it has become nearly saturated with cadmium, is transferred to a clean steel tank equipped with steam coils. Sodium hydroxide is added to the strip in sufficient quantity to precipitate the cadmium as cadmium hydroxide. After adding the sodium hydroxide, the solution is stirred thoroughly to make sure that it is all dissolved. To test the solution for unprecipitated cadmium, a small amount of sodium hydroxide is added to a sample of the strip. If further precipitation takes place, more sodium hydroxide is added to the strip until, by test, no further precipitation takes place. Some ammonia is usually evolved on the addition of sodium hydroxide, so provisions are made to exhaust the ammonia fumes.

After all of the cadmium has been precipitated to cadmium hydroxide, it is allowed to settle. The clear solution

(*Continued on page* 115)



Typical of the many precision electronic parts manufactured by electroforming.

# Electroforming of Precision Military Components

By S. G. Bart, *President, Bart Laboratories Co., Inc., Belleville, N. J.*

ELECTROFORMING, which was formerly known as galvanoplasty, originated over one hundred years ago. Electroforming may be defined simply as "the creation of metallic articles by electrodeposition."

The last decade has seen electroforming receive an impetus which resulted in the manufacture of a large number and variety of products by this technique. Some of these products were such things as searchlight reflectors up to five feet in diameter; radar feed horns up to 24 inches in height; precision electronic radar wave guide tubing, such as elbows and twists; very accurate cavities; high-pressure floats; molds for plastics and rubber; seamless tanks; computing cams; assorted manifolds; rocket bodies; and many, many others too numerous to mention.

Faced with this large variety of products which have been successfully made by electroforming the first thing the uninitiated would ask is "How can I tell whether or not my part can be electroformed?" The evaluation of electroforming is difficult to describe, but there are certain basic principals which can be used to give an initial opinion to anyone who might be interested in the subject. The most important point is the shape of the piece, which determines the type of "mold" upon which the electroform is to be made.

The simplest type of electroforming can be accomplished where sufficient taper is available to allow easy separation of the electroformed part from the mold. An example of this type is the plating of a flat record stamper on a matrix, or a simple tube on a tapered metal mold. In each of these instances very little difficulty is encountered in separating the electroforming from the mold.

The second type of mold is that in which there is no taper, where it is necessary to electroform, for instance, a straight section of rectangular wave guide tubing to close tolerances of say plus or minus .001". In this instance it is possible to take advantage of two important methods; one is to apply a lubricant to the mold over which the electroforming is done. This lubricant could be wax and graphite, or a low melting metal such as tin or lead, which, with the application of a little heat will allow the electroform to be slipped from the mold. The second method is to use metals having a different expansion coefficients, which will enable the electroform to expand more than the mandrel, thus allowing space for separation without marring the interior.

The third type of electroform is that which is made on a disposable mandrel. This type has had a great deal of application in the electronic industry. Examples of this type are electroforms made of fusible alloys, which are cast or machined first; after electroforming, the fusible-alloy is melted out. Other types of mandrels can be used in this manner, such as waxes, plastics, and other materials which have sufficient dimensional stability, and yet are thermoplastic. It is also possible to use as mandrels metals such as aluminum where separation is accomplished by a chemical solution of the mandrel.

Fourth, combinations of the above can be used in electroforming in cases where certain inserts are necessary. These can be cast into the cerro-alloy and electroformed right to the piece, becoming integral when the mold is removed by melting it. It is possible to make two-piece taper molds which can be screwed together, enabling one to form a venturi and yet have permanent mandrels which will be reused. The only limitations on this type of combination are economic ones.

Another point in the evaluation of electroforming, which must be considered, are the structural requirements of the finished part. The electroformer has had available a limited number of metals to work with:

| METAL | TENSILE STRENGTH PSI | HARDNESS (VICKERS) | DUCTILITY (ELONGATION IN 2") |
|---|---|---|---|
| 1. Copper | 20,000-40,000 | | |
| 2. Iron | 40,000-50,000 | 150-165V | 40% |
| 3. Nickel | | | |
| Watts Type *Soft* | 50,000 | 140-160V | 30% |
| Chloride *Medium* | 98,000 | 230-260V | 21% |
| Wesley *Hard* | 150,000 | 400-425V | 6% |
| Low Stress—S | 150,000 | 550-650V | 6-10% |
| Low Stress—SF | 60,000-80,000 | 300-400V | 20% |

The latter two types of nickel have opened up a tremendous field for electroforming. It has given the electroformer new metals which have not only high strength, but are substantially stress free, an extremely important development. In the past there were many applications which were limited because of the fact that a metal strong enough to do the job would warp and would not hold the accurate tolerances required. With the advent of these two new types of nickel a number of applications are now possible which heretofore were extremely difficult, if not completely unobtainable. The question of stress is one which is of vital importance to the electroformer, and is something which must be checked continually. It is extremely disheartening to have a part come out of a bath after five or six days plating and find that stressing has warped it and made it unuseable.

As an example, a soft Watts type nickel has an internal stress of 12,000 to 15,000 psi. In general, a stress of less than 2,000 psi is considered quite satisfactory for the most critical electroforming jobs.

In addition to the structural requirements, there are quite often electrical requirements which will enable the electroformer to produce bi-metal or tri-metal electroforms such as silver, copper, and iron; or silver, iron, and nickel for specific purposes. During the war a large number of tubes were made with gold, copper, and nickel. The gold presented a corrosion-resistant surface, the copper contributed to the conductivity, and the nickel made up the strength of the piece.

One of the newest possibilities which has received a lot of consideration is the use of combinations of metal and rubber "sandwiches" for reducing or deadening electronic waves and insulating parts from one another. The bonds between these layers can be made unusually good.

Electroforming, by its very nature, duplicates the surface on which the metal is deposited. It is therefore possible to deposit metal on a fine finish, finer than 2 MRS, which is relatively easy to get on the mandrel, but almost impossible to obtain on the inside of a part. It also holds that if the most minute duplication of surface can be accomplished, so also can the accuracy of dimensions.

Much has been written about the chemical aspects of electroforming. It is the intention of this article to stress the mechanical phases of electroforming. It is a metal forming operation, and as such is probably more successful when approached from that view.

(*Continued on page* 116)

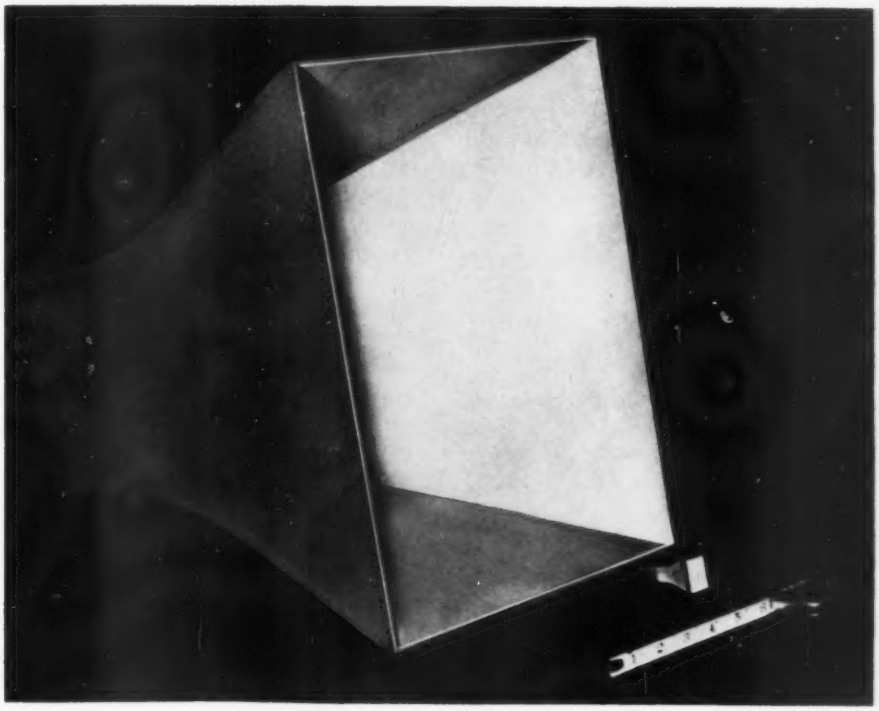
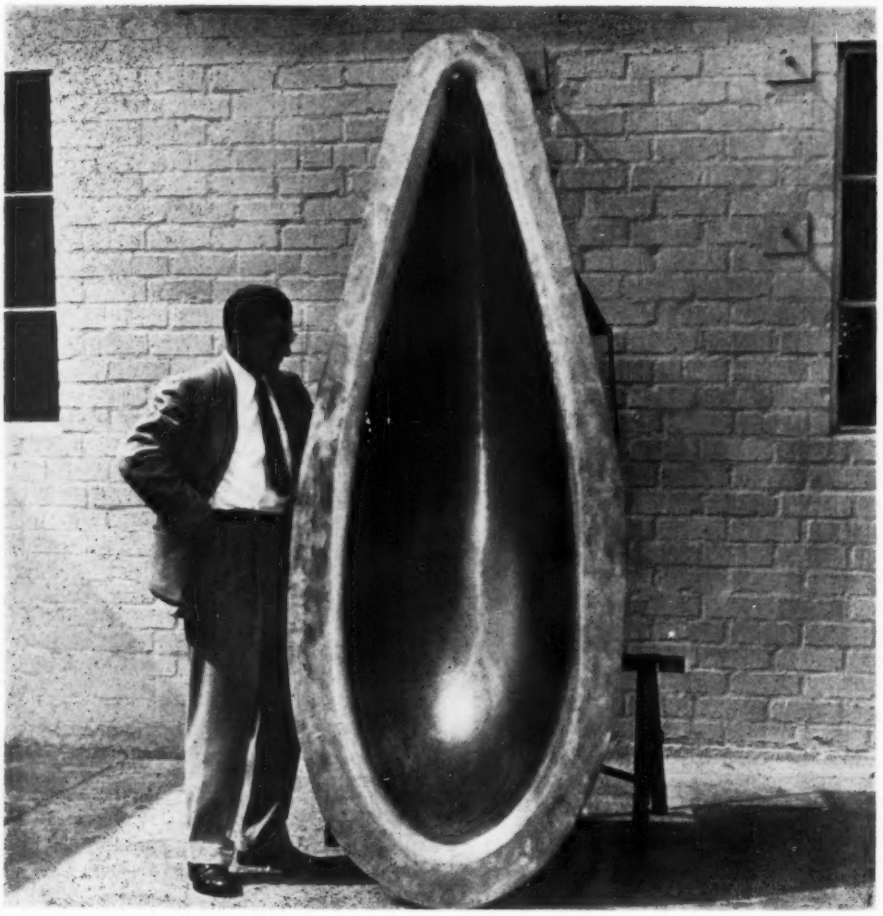


Figure 1. **The wide range of sizes of electroformed parts can be visualized from a comparison of these two radar feed horns.**



**Electroformed Aircraft Radome Mold** — This light-weight one piece mold provides a high quality molding surface free of the pinholes and occlusions normally found in cast metal molds. *(Made by Bone for Zenith Plastics Co., Gardena, Calif.)*

# Military Applications of Electroforming

By M. H. Orbaugh, *Bone Engineering Corporation, Glendale, California*

JUST as happened prior to and during World War II, the current national emergency situation is providing a marked impetus to use of the electroforming process in solving many difficult design and fabrication problems which arise in making the modern implements of warfare.

Including the more recent military applications of the process, the total value of electroformed products now produced in the United States each year exceeds $100,000,000.00.

Foremost among the present military applications are radar waveguide components, radar antennae and radar reflectors, and molds and dies for large aircraft plastic radomes. Also included are venturi nozzles, rocket motor nozzles, computing cams, surface roughness gauges, searchlight reflectors, pilot tubes, aircraft antenna masts, aircraft duct fittings, and aircraft hydraulic fittings.

## *Current Military Applications*

### Aircraft Plastic Tooling

One of the most important uses to which electroforming is being put today is in the greatly accelerated aircraft tooling program. Large dies as much as 14 feet in length (see Fig. 1) are being electroformed in nickel and iron for use in molding reinforced plastic radomes, nose sections, wing tips, rudder tips, stabilizer fins, and other aircraft parts. One of the more outstanding among the several advantages afforded by electroforming such molds is the superior quality, void-free finish obtained on the molded part, which is not readily attainable with any other type of mold. This superior finish is highly desirable on exterior parts of modern high speed aircraft.

Another important reason for utilizing electroformed construction on this type of tooling is that highly skilled labor is not required and can be released for other work. Other advantages of electroforming such molds include light weight, portable construction, simplicity of heating design, and low cost.

A phenolic resin casting is usually used as matrix in electroforming these large molds. The surface of the phenolic matrix is made conductive and then lowered into the electroforming baths where from $\frac{3}{16}$" to $\frac{1}{2}$" of nickel, or nickel backed with iron, is deposited. Since in most cases the molds are used with only a vacuum bag for molding pressure, a $\frac{3}{16}$" to $\frac{1}{4}$" wall thickness is sufficient.

A supporting steel framework is attached by welding to the back of the electroformed shell before removal from the matrix. The matrix may be re-used for making duplicate tools as required. Flexible copper tubes are at-

tached to the back of the mold as specified by the customer. On certain shapes, as is the case with one mold pictured, the electroformed mold is made in two halves with a mating flange attached to each half at the split line.

### Radar Waveguides

The making of precision tubing or waveguides for radar installations in all branches of the armed services, is one of the most ideal applications of electroforming.

Waveguide components include com-

Figure 1. **Giant Electroformed Radome Mold. This is a two piece split type mold used in molding re-inforced plastic aircraft radomes. Steel ribbing has been attached by welding to the back of the ¼" thick electroformed nickel shell. Flexible copper heating tubes have been secured to the outside surface according to customer specifications. Made by Bone Engineering Corp.**
*(Photo courtesy Goodyear Aircraft Corp., Akron, O.)*

plicated twists, bends, transitions from round to rectangular, tapered sections, magic-T sections, turnstile junctions, and telescoped tubing, all requiring a high internal dimensional accuracy of ± .001 inch or less, and a smooth interior surface finish of 3 to 5 microinches. Many such sections would be impossible to fabricate by any other method. See Figures 3 and 4.

The matrices used in electroforming waveguides are usually expendable, being die cast in metals which can later be dissolved out. Injection molded plastic matrices are also used for this purpose and afterwards dissolved out with a suitable solvent.

Where the quantities required are low and do not justify the cost of an expensive die, the matrices are usually machined out of solid stock. In cases where the shape of the part permits, permanent mandrels are made from special alloys so that they can be withdrawn after electroforming and reused repeatedly.

### Aircraft Fittings

A more recent development in the application of electroforming to airframe manufacture and one which promises to be widely accepted throughout the aircraft industry is the electroforming of various types of tubular duct fittings for heating and ventillating systems. See Figure 5.

Readily made over inexpensive, expendable cast matrices, these parts offer the advantages of strong, light weight, one-piece construction with an appreciable saving in critical metals used. Such parts must otherwise be made by welding together several stamped sections which results in a heavier and more costly part.

Chromium-lined iron hydraulic restrictors, a tubular part requiring a high degree of precision, are now being electroformed in large quantities for the aircraft industry.

### Surface Roughness Gauges

The mass reproduction of surface roughness standards by electroforming takes advantage of the ability of this process to faithfully reproduce the finest details of a surface finish. Surface roughness standards are becoming increasingly important as a necessary shop and design tool to more closely control the many types of machining, grinding and lapping operations involved in producing war material.

Starting with an original set of carefully prepared master metal blocks, each one corresponding to a specific microinch value of roughness, electroformed nickel or nickel-faced iron duplicates of the original set are made in quantity by techniques similar to those employed in making phonograph record stampers. Convenient, lightweight portable sets of standard finishes can then be made quickly and at small cost. (See Figure 6.)

### Computing Cams

The computing pin cam shown in Figure 7 is one of several types of similar cams used in the fire-control equipment of battleships and shore batteries.

These are component parts of a precision instrument requiring the combination of high dimensional accuracy, good surface finish, and maximum strength. The conically-shaped pins are arranged in a mathematically determined spiral pattern and must withstand high shear loading. These parts are being currently produced in quantity by the electroforming process, each cam being an exact replica of an original master which was prepared by machining methods.

## *Description of Process*

### The Matrix

In describing the various steps in the electroforming process in their proper order, one must start with the matrix. The matrix, or core, is the most important part of the entire process since it determines the shape, dimensional accuracy, and internal surface

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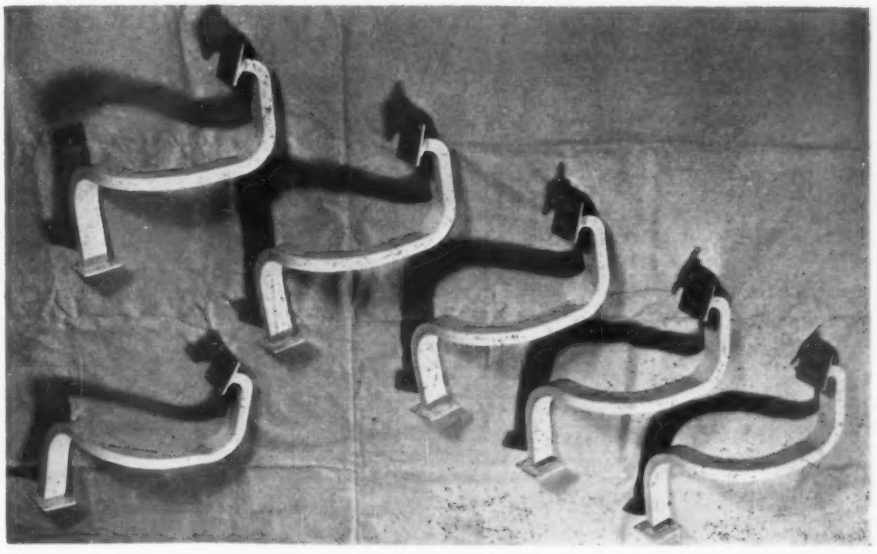
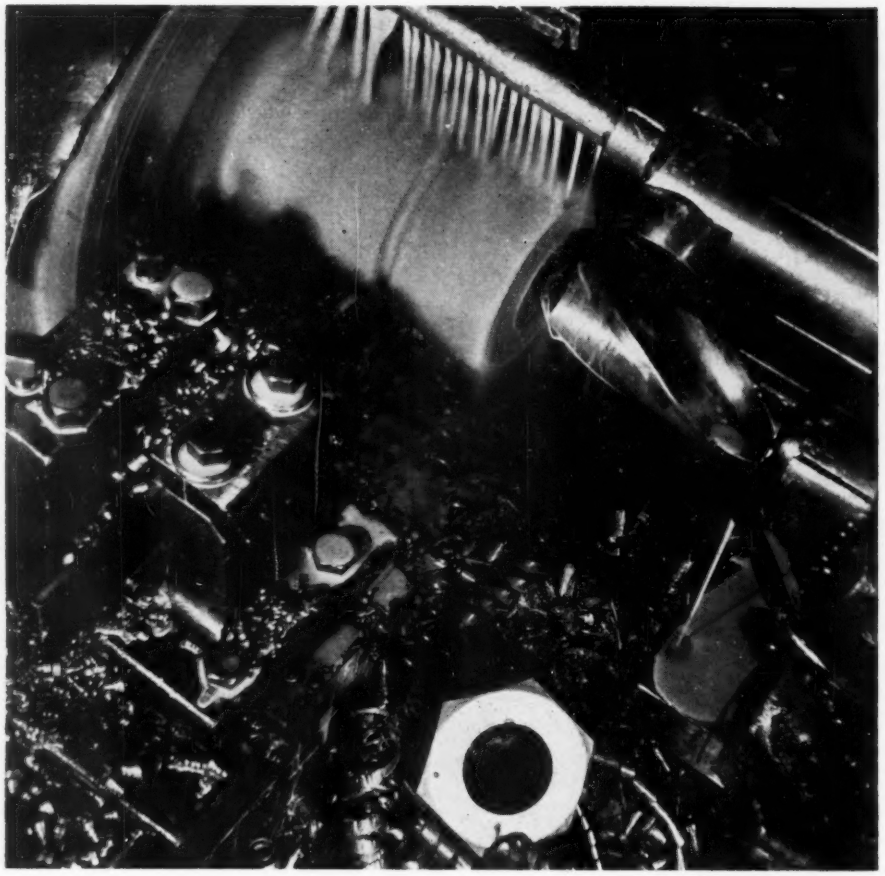


Figure 2. **Radar Waveguide Components — Electroformed in high-strength, low-stress nickel. As a structural part of an airborne radar installation the light weight, rigid construction afforded by electroforming provides a weight saving advantage over other methods of fabrication.**
*(Photo courtesy Bone Engineering Corp.)*



High speed machining of military parts depends on long-lived chrome plated tools, dies, and gauges.

# Hard Chrome Plating—The Industrial Workhorse

By J. A. Williams, *United Chromium, Inc.*

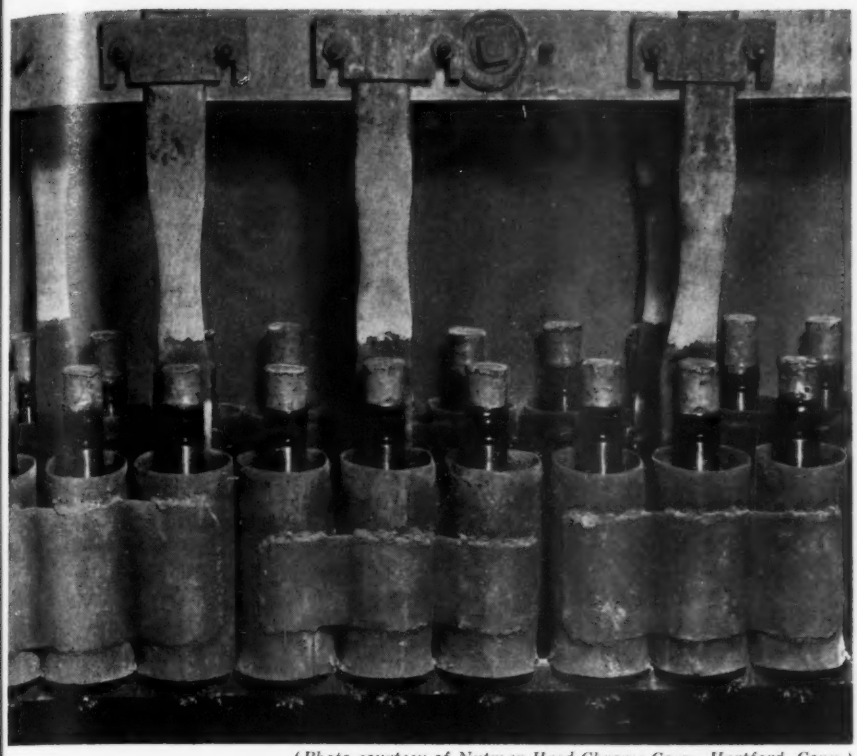
IN the present industrial mobilization program, chromium platers are making great contributions important to national defense, just as they did during World War II. Major activities are now concerned with hard chromium plating, which did so much during the last war to provide our fighting men with the best and safest equipment that could be produced.

In addition to its well known decorative applications, chromium has many engineering uses which conserve labor and strategic materials essential to the defense of the country. Hard chromium plate is also used to salvage worn or mis-machined parts that might otherwise have to be scrapped.

Before outlining the many applications for hard chromium, we wish to briefly review the meaning of the term "hard chromium" and also point out the properties of chromium plate which make it such a valuable engineering material. Decorative chromium and

*(Photo courtesy of Nutmeg Hard Chrome Corp., Hartford, Conn.)*

Figure 1. Aircraft crankshafts set up for hard chrome plating of the bearing journal areas. Note auxiliary anodes in place and masking devices.



*(Photo courtesy of Nutmeg Hard Chrome Corp., Hartford, Conn.)*

**Figure 2. Production set-up for hard chrome plating small shafts.**

bright, hard chromium differ primarily in the matter of *thickness* only, decorative chromium usually being on the order of 0.00001" thick and hard chromium commonly 0.001 to 0.010", but frequently both higher and lower; thus when platers speak of hard chromium, they really mean thick chromium for engineering applications.

### *Properties of Chromium Plate*

Chromium is the hardest metal commercially electrodeposited, having a hardness rating equivalent to 1000 Brinell. On Moh's scale, chromium has a rating of 9 as compared to a rating of 10 for the diamond. The extraordinary hardness of chromium makes it ideal for application to many wearing surfaces.

The non-galling property of chromium is perhaps its most important engineering advantage. The slickness and low coefficient of friction of chromium have many industrial applications. The coefficient of friction, which indicates how easily one surface slides on another, is found by dividing the force required to move one surface over another by the force pressing the two surfaces together. To the engineer designing equipment with moving parts, the coefficients of friction of those parts are tremendously important. If, for example he has a part that must slide on cast iron he will investigate the coefficients of friction of various suitable metals for the sliding part. He would find that the coefficient of friction for highly finished hardened steel sliding on cast iron is 0.22; for bright chromium plate sliding on cast iron, the coefficient is only 0.06. In this case chromium plate is between three and four times more "slippery" than hardened steel.

The excellent corrosion resistance of chromium also makes it a preferred material for use on precision parts. Where chromium is used, there can be no sticking resulting from accumulation of corrosion products. Chromium is resistant to so many chemicals that it is simpler to list those few materials which do attack it. Such a list would include hydrochloric and hydrofluoric acids, certain chlorides such as copper and mercuric chlorides, dilute sulfuric acid, and formic acid.

Chromium also has very good resistance to heat. It is unaffected at temperatures at which many metals are rapidly oxidized. Even when chromium is subjected to comparatively high temperatures the green chrome oxide that is produced is adherent, smooth and glass-like. This property is of great importance to many manufacturers, such as producers of sheet glass who use hard chromium plated rollers on conveyors for red-hot sheets of glass. Although green chrome oxide is formed on these rollers, the oxide coating remains adherent and slick and the hot glass sheets will not stick to the rollers.

In most hard chromium applications, it is not just a single property of the plate that makes it such an important defense tool. It is usually the unique *combination* of properties possessed by chromium — the sum of its hardness, slickness, low coefficient of friction, heat resistance, and corrosion resistance.

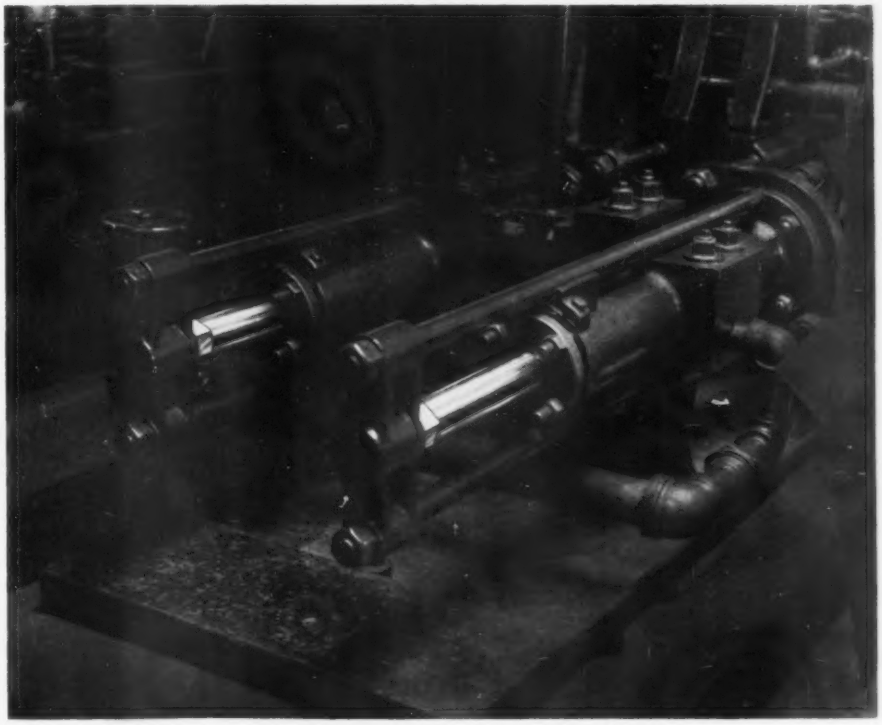


**Figure 3. Hard chrome prevents wear and production breakdowns in vital power equipment for America's war plants.**

### *Hard Chromium Applications*

Hard chromium is used on a great number of parts for military equipment. One of the more important military applications is on gun barrels. Before the days of hard chromium plating, gun barrels made of specially treated steel had a comparatively short service life. The hard chromium plated barrels in use today have much greater resistance to wear, provide longer service, and retain their accuracy for much greater periods of time than their unplated forebears. A hard chromium plated barrel is said to last several times longer than an unplated, treated steel barrel.

Other parts of guns are also hard chromium plated. Anti-aircraft, as well as a number of other guns, have plated mount bearings. Hard chromium plate is also used on cylinders controlling auto-firing robots for aircraft machine guns.

Hard chromium is also widely used on a number of moving parts of torpedos. Parts that are plated include forward and aft propeller shafts and sleeves, spring levers, rudder adjustment rods, etc.

Many aircraft parts and assemblies are hard chromium plated. Among them are steel bushings, hydraulic pistons, naval aircraft landing and catapult hooks, landing struts and pistons, brake rings, and aircraft engine cylinders. See Figures 1 and 2.

Where oil-retaining surfaces are desired, such as on some engine cylinder liners, porous chromium is employed. In this type of hard chromium, crack structure of the plate is carefully controlled so as to retain friction-reducing oil.

Hard chromium is also used on many of the tools and machines used to manufacture defense-essential supplies and equipment. A great variety of parts so finished are tabulated in Table I.

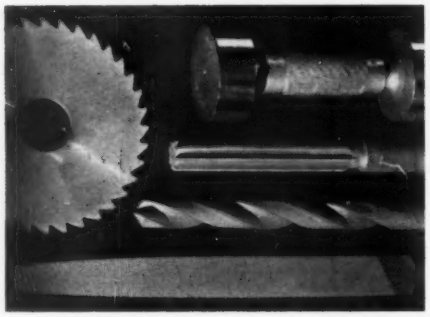


**Figure 4. Hard chrome plated tools and gauges are vital to the tremendous production programs of this country during mobilization for defense.**

### *Table I*

### *Partial List of Tools, Machines, and Parts That Have Been Hard Chromium Plated*

| | |
|---|---|
| Adapter sleeves | Jigs |
| Angle bars | Journals |
| Anvils | Kettles |
| Apron boards | Knives |
| Arbors | Lathe centers |
| Ball bearing races | Leather press plates |
| Ball bearings | Leveller rolls |
| Bars | Limit gauges |
| Bearings | Liners |
| Brake drums | Mandrels |
| Breaker rolls | Mess trays |
| Broaches | Micrometers |
| Burnishers | Mill coaters |
| Calender rolls | Mirrors |
| Calipers | Mixers |
| Cams | Molding dies |
| Camshafts | Molds |
| Carrying rolls | Pans |
| Cheese screens | Pasteurizer coils |
| Chemical mixing equipment | Patterns |
| | Photoengraved rolls |
| Clutch rings | Pinions |
| Coal briquet rolls | Pins |
| Coating rolls | Piston rings |
| Collars | Plugs |
| Conveyor rolls | Plug gauges |
| Couch rolls | Plungers |
| Crankshafts | Press plates |
| Creping rolls | Printing plates |
| Cutters | Printing rolls |
| Cylinders | Pulleys |
| Dental burrs | Punches |
| Dies | Racks |
| Distributor shafts | Rams |
| Doctor blades | Ratchets |
| Drawing dies | Reamers |
| Drift pins | Ring gauges |
| Drills | Rocker arms |
| Drying drums | Rollers |
| Drying plates | Rotary seals |
| Embossing rolls | Schreiner rolls |
| Evaporator tubes | Scraper plates |
| Extruding equipment | Scraper rolls |
| Facing tools | Scrapers |
| Feed rolls | Screen plates |
| Filters | Screws |
| Flattening rolls | Shafts |
| Formers | Shock absorbers |
| Gauges | Shoes |
| Gears | Spindles |
| Gluing rolls | Splines |
| Graining rolls | Sprockets |
| Grinding machinery | Steam plates |
| Guides | Studs |
| Heat exchanger plates | Stuffing boxes |
| Heat exchanger tubes | Suction box covers |
| Hobs | Taps |
| Hoppers | Tensions |
| Idler rolls | Tinsel rolls |
| Impellers | Tool bits |
| Impression rolls | Valves |
| Instruments | Worms |
| Ironing rolls | |

### *Value of Hard Chromium*

Case histories illustrating the value of hard chromium plating are numerous. One case in which hard chromium extended the life of a part subject to wear and corrosion took place in a rubber plant. This company found that

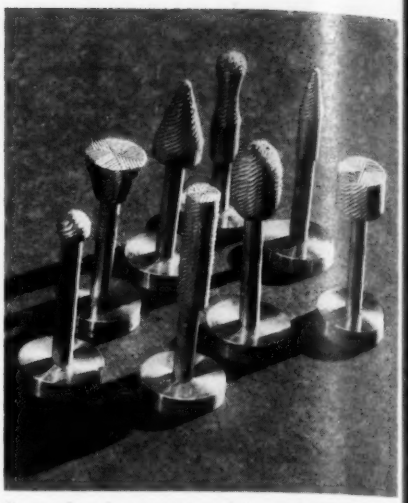


**Figure 5. A group of metal working burrs, hard chrome plated. Such special tools eliminate or speed up finishing operations on many critical parts for military items.**

plated piston rods on high pressure hydraulic pumps outlasted unplated pistons four to five times. Other advantages gained by hard chromium plating were reduction of packing wear by about 80%, reduction of frictional resistance, and elimination of rust. See Figure 3.

Hard chromium plays an important part in the production of seamless drawn tubes of both ferrous and nonferrous metals. It has been found that chromium plating increases the life of the dies and mandrels up to ten times, and in addition, provides a higher finish than unplated ones. Other advantages are greater reduction per draw and increased production.

Many of the tools used in the production of ordnance equipment are hard chromium plated. For example, forming tools used in the manufacture of metal ammunition storage boxes last eight to ten times longer than unplated tools.

The low coefficient of friction of chromium is important to users and producers of ring gauges. The slippery chromium eliminates possibility of the gauge seizing or scoring the work.

Millions of worn or mis-machined parts have been reclaimed by hard chromium plating, not only conserving vital materials but also helping to avoid costly production delays. In one case a contract plater was able to reclaim a worn spindle for an automatic screw machine at only 20% of the cost for a new spindle. What is more, he saved the manufacturer almost three weeks

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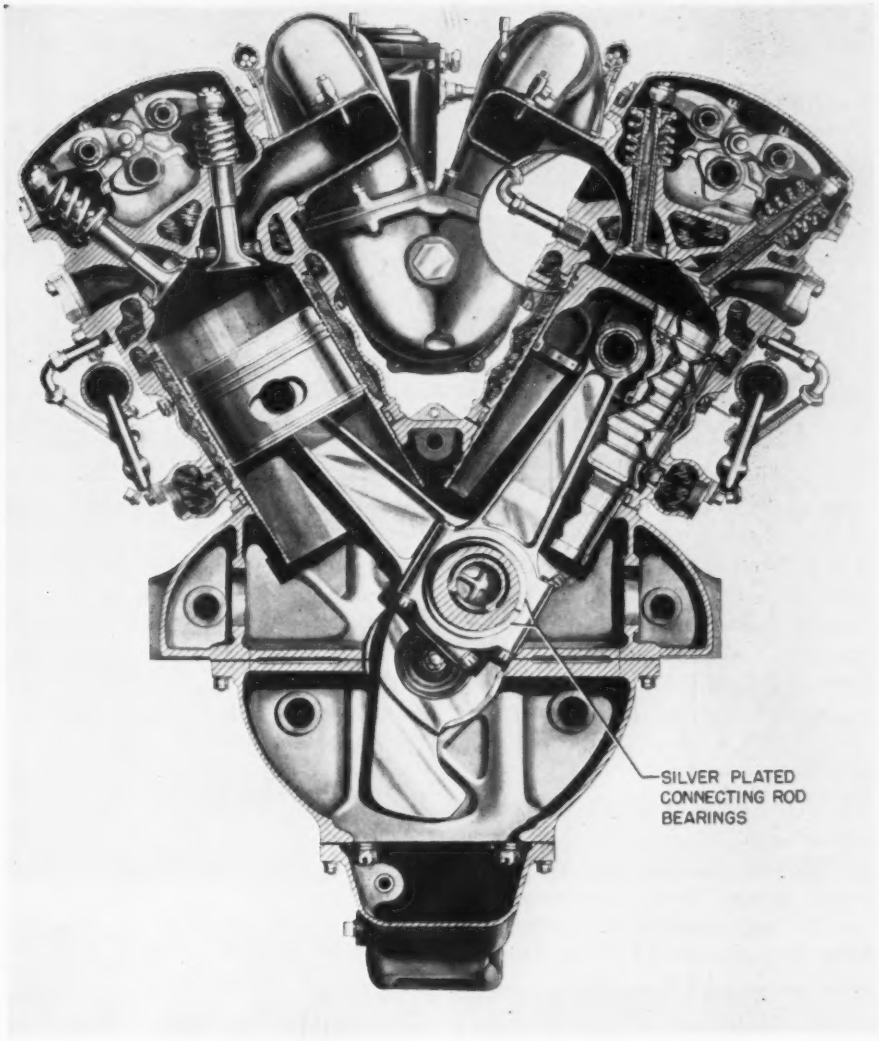
# Heavy Silver Plating of Bearings

By Frank C. Mesle

*Oneida Ltd., Oneida, N. Y.*




*(Photo courtesy Allison Div. General Motors)*

TRIPLE and quadruple plated silver tableware was at one time considered as "heavy" silver plate, and was difficult to produce. In order to get a reasonably smooth deposit that could be finished by burnishing and buffing it was necessary to remove the work from the plating vat several times for scratch brushing during the plating period. ("Quadruple" plate is approximately .0014" thick.)

One of the outstanding developments of the last war, and one which will play an equally important role in the present preparedness program, is the use of heavily silver plated bearings for aircraft purposes. In a military sense, "heavy" silver plating means deposits of .020"-.060", far thicker than even the heaviest of the decorative type silver plates! Heavy silver plating of bearings is a large scale operation, and one of the most important contributions of the plating industry to our military might.

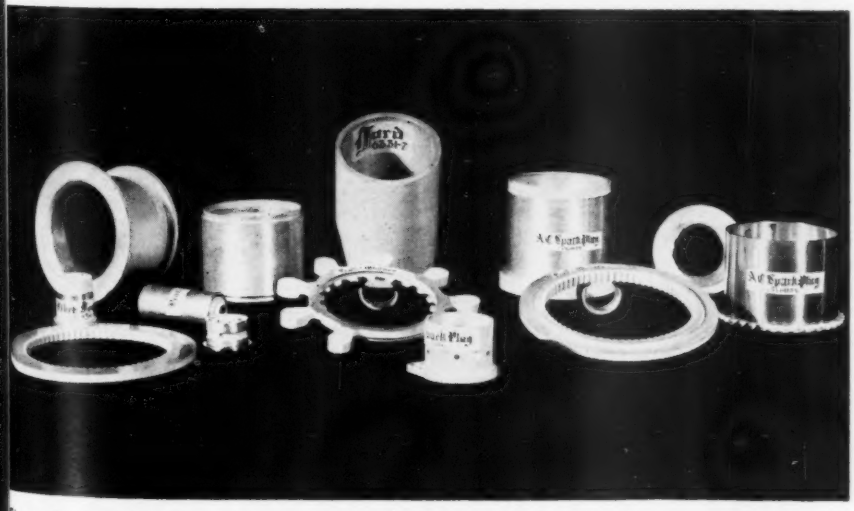


Figure 1. A typical group of heavy silver plated bearings, showing the variety of surfaces to be coated.

Why use silver bearings? The answer lies in the millions of silver bearings used in engines for aircraft, tank and other motor driven vehicles (and some boats) during the second World War. These have demonstrated the value of the silver bearing in terms of much longer life in comparison to the conventional copper-lead alloy bearing.

The four vital factors that determine the quality of a bearing material are, in the order of their importance, fatigue resistance, corrosion resistance,

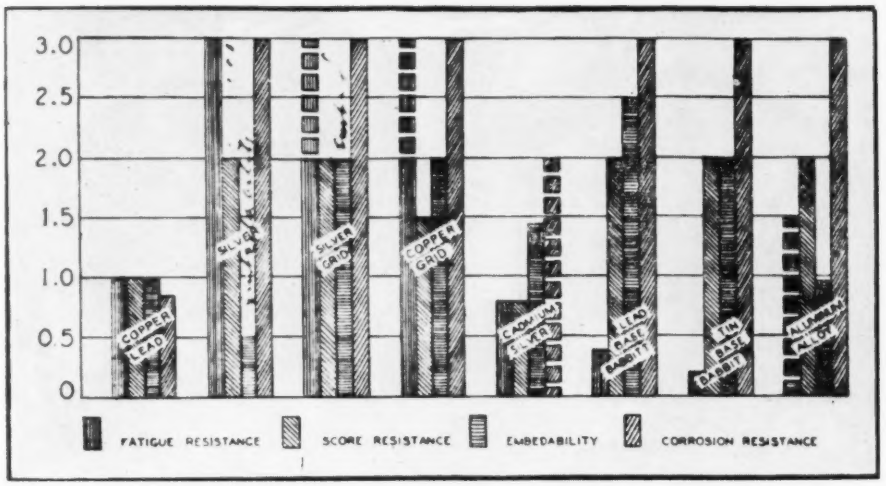



Figure 2. Comparison of life of silver bearings with other common types. Copper-lead is taken as unity.

score resistance, and embedability. The different common bearing materials are rated in the order of decreasing performance, as follows: Silver-lead-indium, silver-lead-grid, copper-lead-grid, copper-lead alloys, aluminum alloys, cadmium-silver alloys, lead-based babbit, and tin-based babbit.

The charts, 1 and 2, indicate to what extent the four factors are present in the various bearing materials mentioned above. Recent developments seem to have changed the rating between the plain and the grid surface for

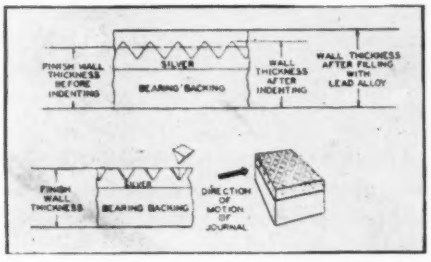



Figure 3. Bearing selections showing indenting details for lead inclusion.

silver bearings, placing the grid surface in first place. Chart No. 3 illustrates the kind of surface on the grid-surfaced bearing.

There are at least three methods of producing bearings:

1. Casting the silver on the steel shell.

2. Thermally bonding silver to steel. The operations consist of cladding a steel bar and a silver bar together under pressure and temperature and rolling in a composite strip to the size and thickness of silver desired. The thickness of the silver is determined by the size of the silver bar used at the start of the bonding operation. The silver clad method cannot be used for preformed shells or on other items that may require forming and finishing prior to the application of the silver.

3. Electroplating heavy deposits of silver to one side of strip steel (when strip steel is used) or plating the preformed shell with silver on what is to be the bearing surface.

This article deals primarily with heavy silver plating as a method of applying silver to the steel backing, either in the flat or formed bearing back.

In producing a satisfactory silver plated bearing it is necessary to plate the required thickness of silver only on the bearing surface. The silver must be well bonded to the steel back, must be free from excessive pores and nodules, and must be of uniform fine-grain structure.

To plate only the bearing surface requires the use of stop-off materials such as tape, stop-off paint, high melting point wax, molded rubber masks, or a combination of these materials. Figure 3 illustrates how these masking materials are used.

Bearings are plated according to the need, some inside only, others outside only, some both inside and outside.

The most important single quality is the bond strength between the base and the silver. If the silver can be separated from the base with the aid of a hammer and chisel the bond is not satisfactory.

After plating with silver, bearings are heated to a temperature of between 950-1000°F for one hour. This heat treating originally was intended as a test for the bond, and will cause blistering at very poor bond areas, and

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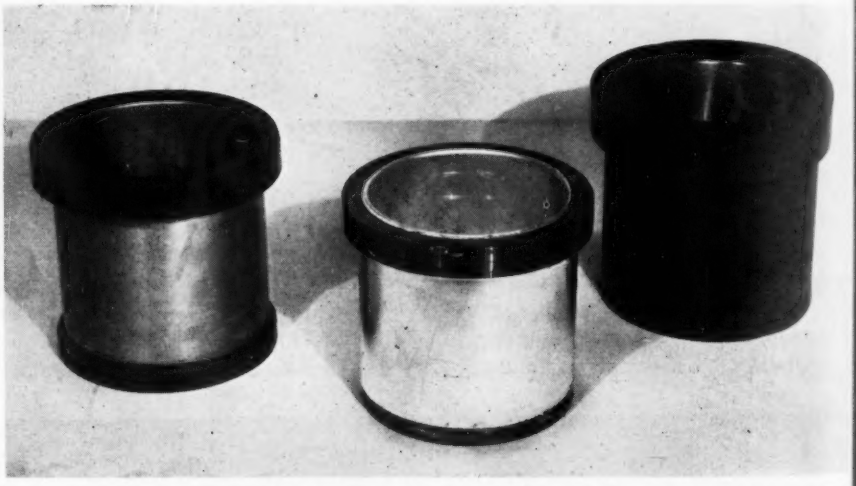
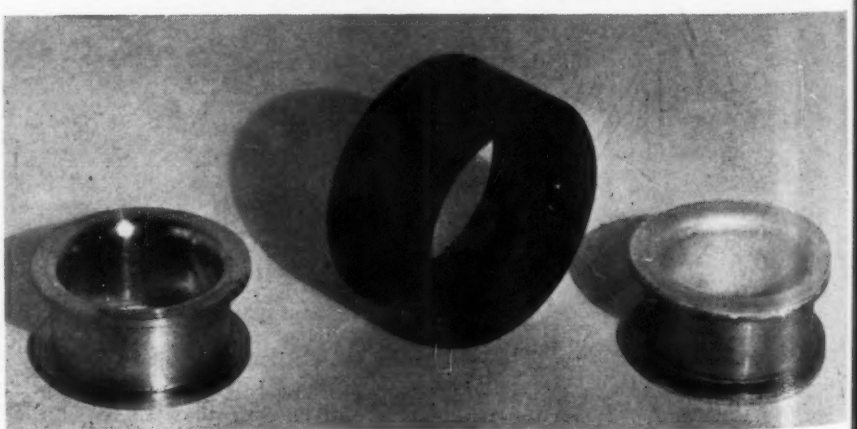
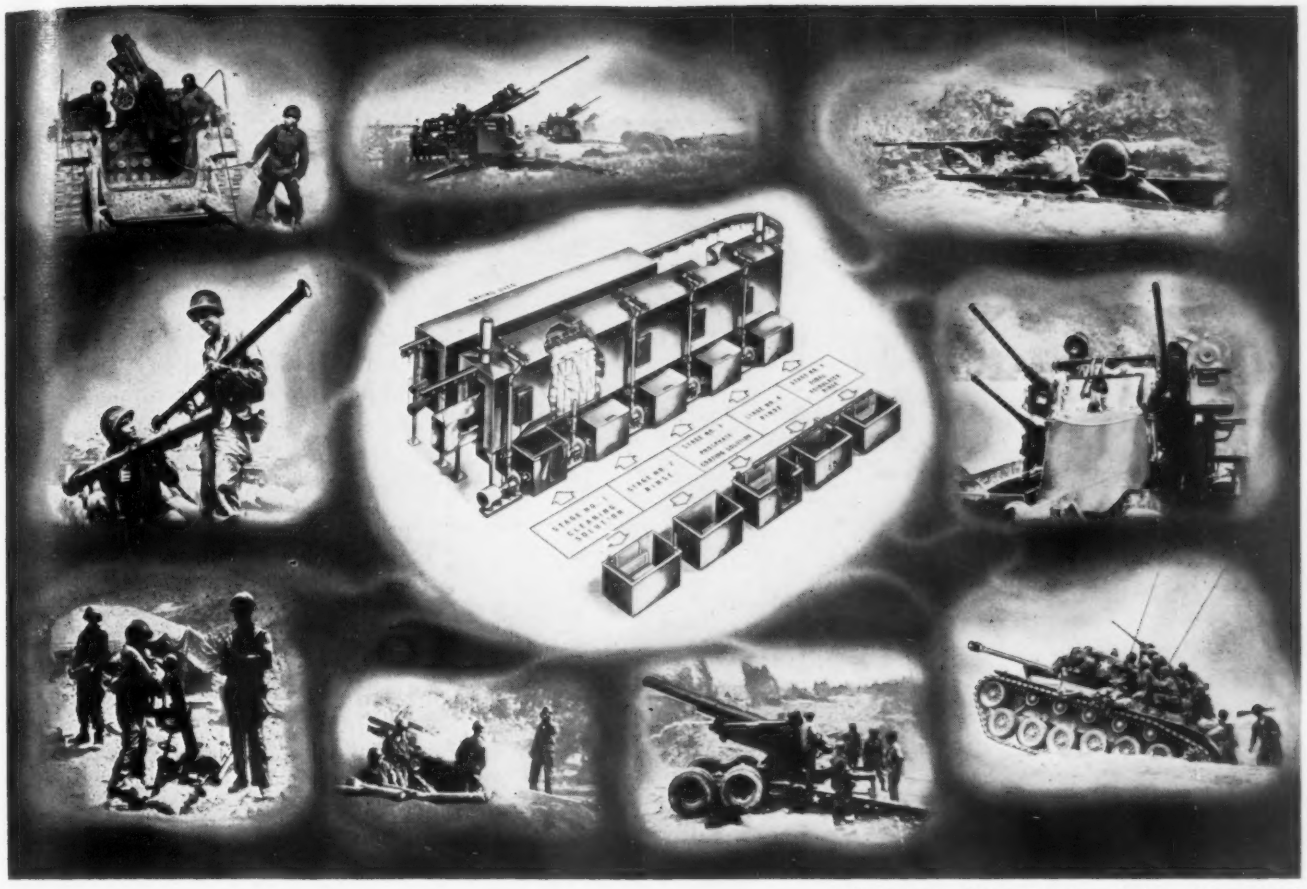


Figure 4. Masking methods for bearing surfaces. Bottom group shows, left to right, unplated bearing, rubber mask, finished bearing.





*(U. S. Army photos. Courtesy "Ordnance" magazine)*

Typical phosphating equipment and some defense products which are phosphated.

# Phosphate Coatings in Defense Production

By **Alfred Douty**, *Chief Chemist, American Chemical Paint Co., Ambler, Penna.*

So called conversion coatings are produced by the action of reagents on metal surfaces. They consist of insoluble metal compounds which affect the appearance, corrosion resistance, wear resistance, electrical resistance and other surface properties. Of the conversion coatings, those consisting mainly of insoluble metallic phosphates have achieved possibly the widest range of usefulness.

Experience gained during and since World War II in the United States, in Germany, England and in France has emphasized the importance of at least the following applications of phosphate coatings in defense production.

Paint-bonding to iron, zinc, cadmium, aluminum, and their common alloys.

"Rust-proofing" of iron, steel, aluminum, with or without the aid of corrosion-preventive oils, etc.

Protecting friction surfaces of ferrous metal.

Improving cold drawing, cold extrusion, and cold forming of steel.

### *Paint Bonding*

Phosphate coatings for bonding paint and other organic finishes to metals are effective because they provide excellent protection with a relatively thin and flexible paint film. In contrast, the multiple-coat paint system used in the pre-phosphate coating era was brittle, costly and lacking in protection.

On metal surfaces — usually, steel, iron, zinc and aluminum — that have been freed from rust, oil and soil, phosphate coatings are formed by dipping the work into the coating baths, carrying it through the several sprays in a multi-stage power washer, or applying the coating solutions with a brush. The method to be used is determined by the type of work, its size and the number of pieces to be produced.

In all cases, the final rinsing of the coated work preparatory to painting is an important part of the process, for salts in untreated tap water can leave objectionable paint-blistering and paint-shedding residues. These residues are destroyed by the addition of the proper amounts of chromic or chromic-phosphoric acids to the final rinse bath.

### *Applying Phosphate Coatings*

#### Spray Processes

This process is best suited for similar work, large or small in size, where high rate of production is wanted.

When products are of the same general design, constructed of sheet metal and adapted to processing on a monorail conveyor or belt, a multi-stage power washer of 5 or 6 stages is the most convenient equipment to use, whether the products are large, like auto or bus bodies, or relatively small,

*Table 1. Phosphate Coatings for Paint Bonding*

| | STEEL | | | ZINC OR CADMIUM COATED METAL Galvanized steel, heavy Cd plated | Electroplate or zinc base die casting. | ALUMINUM (PURE OR ALLOYED) |
|---|---|---|---|---|---|---|
| General form and examples of Products | Cold rolled stampings H.R. pickled sheets, etc. Automotive sheet metal, steel drums. | | Machined objects, pickled forgings, Shells, rockets, | Erected structures, truck bodies | Continuous strip<br>Small parts. | Sheet metal stampings, Truck bodies alum. tiles<br>Cast or wrought parts. Continuous strip; sheet metal. Automotive parts, aircraft parts. |
| Available methods of application | Power spray washer, Hand brush, portable spray apparatus | Power spray washer | Power spray washer, Dipping | Hand brushing or spraying. Brief dipping followed by delay before rinsing. | Power spray washer, dipping | Power spray washer, dipping, handbrush or manual spray |
| Type of coating | Zinc phosphate | Iron phosphate | Zinc phosphate | Zinc phosphate | Zinc phosphate | (1) Zinc phosphate crystalline<br>(2) Aluminum-chromium phosphate, amorphous |
| Coating weight mg./sq. ft. | 100 to 400 | 30 to 100 | 200 to 600 | 200 to 600 | 75 to 500 | 100 to 300<br>100 to 250 |
| Coating time, min. | Power spray 1, Portable spray 2—5. | 2—3 | Power spray 1—2, Dipping 2—5 | 2 to 15 including delay before rising. | 0.5 to 2.0 | 1 to 3<br>0.3 to 2 |
| Typical Government Specifications applying | USA57-0-2, Type II, Class C; JAN-C-490, Grade I | ———— | USA57-0-2, Type II, Class C; JAN-C-490, Grade I | AN-F-20<br>USA72-53 | AN-F-20<br>USA72-53 | MIL-C-5541<br>MIL-S-5002<br>AN-F-20 |
| Hours ASTM, salt spray resistance required or expected. | 250 with specified paint | Painted 150 to 500 depending on paint | 250 with specified paint | Not specified. At least as great as for zinc phosphate coatings on steel | ———— | 168 hours unpainted<br>500 hours with specified paint. |

(1) This type of process is designed to furnish crystalline zinc phosphate coatings somewhat similar to those used on sheet steel for paint bonding. It is possible to process several different kinds of metal in the same solution.

(2) This type of coating affords superlative paint bonding and enormously increases organic finish life. It is also suited to resist corrosion without supplementary coatings. Modifications are available for different services.

like radio cabinets. Labor is required only to hang the parts on the continuous conveyor and to remove them at the proper place when finished.

Parts which are being so treated in preparation for painting comprise:

Automotive stampings and assemblies of steel.

Cabinets, foot lockers, etc. of steel.

Aluminum building siding, cabinets, washing machine tubs, aircraft parts.

In addition, multi-stage spray machines for coating continuous strip is in use on:

Aluminum strip of various widths, such as venetian blind stock.

Zinc plated steel strip.

A modification of the multi-stage power washer with its continuously moving chain or belt conveyor may be used when the number of parts to be processed is relatively small, when floor space is restricted and when the products are relatively large. Such equipment would provide five compartments into which the product is pushed and left in the spray, till the cleaning, rinsing, and phosphating operations are complete. Parts so handled include:

Truck bodies of steel, galvanized steel, and aluminum.

Large ordnance items of steel, galvanized steel and aluminum.

A further modification for still smaller production would provide a tank-like structure into which the product, previously hand-cleaned with a solvent wipe, is placed and the phosphatizing solutions sprayed on the entire surface with a spray nozzle. Miscellaneous automotive equipment, etc., has been so treated for a long time.

### Immersion Processes

This process is best suited to miscellaneous products, large or small, requiring medium production.

For products small enough to be processed in tanks singly or on racks, in crates or in tumbling barrels, a dipping process is often indicated. In the case of zinc phosphate coatings on iron, steel or zinc, coatings can be produced that are similar in weight, texture and paint-bonding effect to those produced by spray processes.

Freshly pickled surfaces may require special pretreatments to assure the finest grain structure in the coating. This is also true of parts which require strong alkali for cleaning. Amorphous phosphate coatings on aluminum are likewise readily produced in a dipping tank system.

Chance-Vought "Cutlass" fighter. Practically all painted surfaces on this plane are phosphate coated.

Examples of work coated for paint adhesion by dipping processes are:

Shells and rockets of various sizes
Switch gear of steel and galvanized steel
Ammunition components of aluminum
Gas mask parts
Aircraft sub-assemblies of aluminum

BRUSH PROCESSES OR PORTABLE SPRAY PROCESSES

For coating assembled structures which cannot be processed in spray washing machines or tanks, the processing solutions must be applied by means of brushes or by means of manual spray guns similar to paint spray guns. Fortunately, effective processes of treating steel, zinc and aluminum are available for use with these techniques. Among the kinds of work which are commonly treated in this way are:

Bridges, gas-holders and other steel structures
Galvanized buildings and signs
Large automotive and railway equipment of steel
Assembled airplanes, buildings, etc. of aluminum
Refinished and rebuilt equipment of all kinds.

### *Rust Proofing*

When cleaned iron or steel surfaces are treated by immersion in a suitable solution of either manganese or zinc phosphate coating chemicals, the entire surface is converted to a complex crystalline phosphate coating integral with the basis metal. This protective layer has at least two important characteristics. First, it acts as an insulator and therefore tends to repress electrolytic corrosion. Second, its protective effect is greatly enhanced if the phosphate coating is given a final aqueous rinse in a weak chromic acid bath and then "sealed" with a rust preventive oil or wax. The nature of these phosphate coatings is such that they adsorb and hold relatively large quantities of the sealer, yet present a surface that is "dry" to the touch.

Rustproof coatings find many practical applications. During World Wars I and II most small arms were rustproofed by phosphate coating and impregnated with chromic acid and a rust preventive oil, or cutback petrolatum. This not only provided excellent corrosion resistance but also yielded a dull black non-reflecting surface. Rustproof finishes are now used widely on hardware, firearms, cartridge clips, metallic belt links, miscellaneous forgings and castings, tools, unpainted replacement machine parts, and many other similar items such as bolts, nuts and washers.

Coatings of this type are usually produced by dipping processes. Times of from 15 to 30 minutes and coating solution temperatures of 190 to 210° F. are employed. Because of the high temperatures and long times of processing, spray processes are generally impractical.

A variety of supplementary treatments is employed over coatings of this kind. Usually oils or so-called "cut back" petrolatum rust preventives are used. The surface may be stained black or left unstained, and the auxiliary coatings may leave the surface dry or oily in appearance. Sometimes thin lacquers, transparent or black, are applied.

A few parts to which this type of rustproofing is commonly applied are:

Nuts, bolts, washers, screw machine parts of steel.
Machine gun links.
Tools.
Small arms, barrels.

It must be noted that the term "rust-

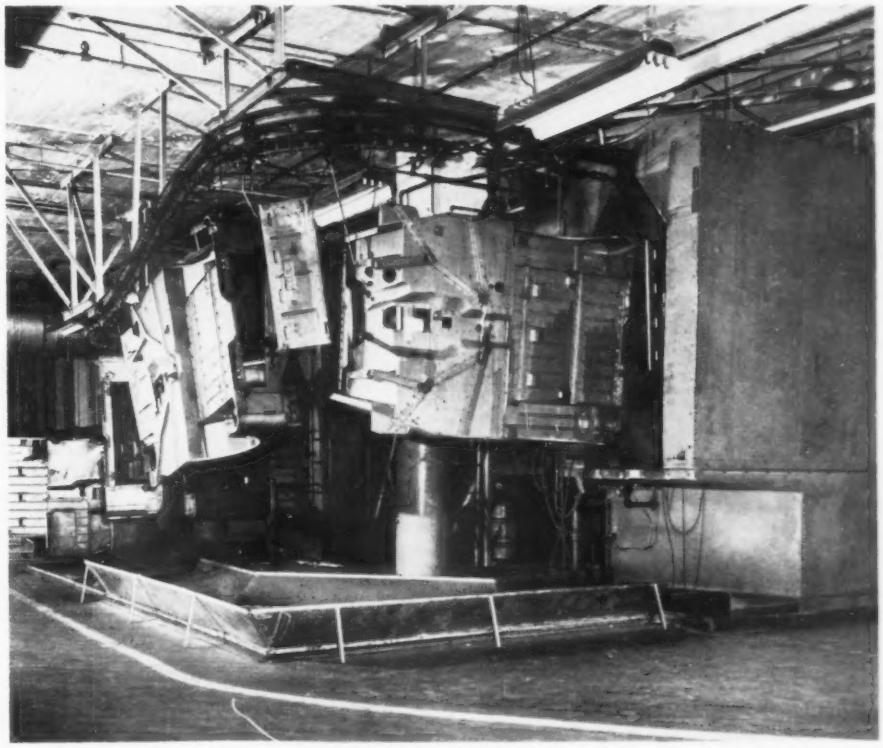


Figure 1. Phosphate coated military vehicles emerging from continuous coating apparatus.

### *Table II. Phosphate Coatings for Rustproofing*

| | *STEEL*<br>*Cold-rolled, hot-rolled, pickled, forged* | STEEL AND CAST IRON |
|---|---|---|
| General form and examples of products | Hardware, nuts, cartridge clips, guns. | Small arms, components, nuts, bolts, machined parts |
| Supplementary treatment | Protective oils, waxes, etc. (Note 2) | Protective oils, waxes, etc. |
| Type of coating | Zinc phosphate | Manganese phosphate (Note 1) |
| Available methods of application | Dipping, barrel tumbling | Dipping, barrel tumbling |
| Coating weight—mg./sq. ft. | 1000 to 4000 | 1000 to 4000 |
| Usual coating time, min. | 20 to 30 | 15 to 30 |
| Typical Government Specifications applying | USA57-0-2, Type II, Class B | USA57-0-2, Type II, Class A |
| Hours salt spray required or expected | Bare 2; with rust preventive 36 (Note 3) | Bare 1; with rust preventive applied 24 (Note 3) |

*Notes*:

(1) *This type of coating is also extensively used to impart wear resistance to ferrous metal bearing surfaces.*

(2) *These coatings, especially the zinc phosphate type, are occasionally relied on for corrosion resistance unprotected by oil, etc.*

(3) *These coatings properly prepared are rinsed, and bearing suitable protective oils, waxes, etc., will withstand considerably more than the specified salt spray hours.*

proofing" has been here restricted to the reduction of corrosion rate of iron or steel articles without the use of paint or other "permanent" organic protective coating. If this notion is extended to other metals, it may be remarked that aluminum also is often protected from corrosion by amorphous chromium-aluminum phosphate coatings without paint or the like.

### *Protection for Friction Surfaces*

Fabricators and product designers, particularly in the automotive field, are aware that even highly polished surfaces under friction weld, gall and score. One of the most inexpensive and practical methods of preventing this is to coat the metal to prevent metal-to-metal contact. With cast iron or steel the manganese-iron phosphate type of conversion coating provides a wear-resistant layer of unusual effectiveness. It is normally used on such friction surfaces as pistons, piston rings, rocker arms, camshafts, levers, valve tappets, cylinder liners and spiders for universal joints.

The unique properties of the manganese-iron phosphate coating which enable it to protect the underlying metal so effectively are both chemical and mechanical. By preventing metal-to-metal contact, the coating removes the danger of welding. In addition, the coating deforms under pressure, thus reducing maximum stresses. The mild abrasive properties of the manganese-iron phosphate coating assist in lapping or wearing-in the parts which are rubbing together. This effect is greatly enhanced by the adsorption of a lubricating oil by the manganese-iron phosphate crystals. Finally, the etching action of the coating solution produces a porous surface under the coating, which improves the wearing qualities and leaves minute oil reservoirs when all traces of the coating have disappeared.

**Figure 2. Diesel cylinder liners. Right hand liner coated with manganese iron phosphate to reduce wear and facilitate break in.**

Tin plating of friction surfaces once was very widely practiced to facilitate "break-in" or "wearing-in" of parts. However, because of the strategic nature of tin and the high cost of tin plating, the phosphate finish has replaced it in many instances, often with improved performance. The manganese-iron phosphate film is superior

(*Continued on page* 120)

### *Table III. Applications of Zinc Phosphate Coatings To Improve Drawing and Extrusion*

| | |
|---|---|
| General Forms | Steel. Occasionally galvanized steel.<br>Wire, bars, rods, tubing, stampings, cups for shell cases.<br>Flat polished bars for plating after drawing.<br>Slugs for cold extrusion. |
| Available methods of application | Dipping, barrel tumbling, power spray washer. |
| Type of coating | Zinc phosphate, sometimes with trace of metallic copper. |
| Coating weight — mg./sq. ft. | 150 to 3000. Controlled by time, temperature and bath composition. |
| Coating Time — minutes | Dipping — 1—10<br>Spraying — 0.5—2 |

Typical of the many military parts finished with chromate conversion films.

# Chromate Finishes in War and Peace

H. C. Irvin, *President, Allied Research Products, Inc., Baltimore, Maryland*

**Defense production, 1951, is unique. In addition to the military production, civilian production remains at a high level. Chromate coatings fill an important place in both programs, provided their properties are recognized and applied correctly.—ED.**

CHROMATE finishes, sometimes referred to as conversion coatings, have gained considerable popularity as finishes for zinc, cadmium, aluminum, copper, brass and bronze since their volume introduction during World War II. This progress, combined with today's metal shortages, restrictions on metal usage, and greater emphasis on government production, makes desirable a better understanding of the characteristics and abilities of chromate finishes.

### *Nature of Chromate Films*

For those few who may be unfamiliar with these products, let us start with a brief statement as to the nature of these compounds. They are not to be confused with the chromate primers used so widely as an undercoat for outdoor paints — the metal finishing chromates are immersion chemical coatings for the metals listed above. They are non-electrolytic and usually operate at normal room temperatures. Since the parts to be treated are simply immersed in the chromate solution for a few seconds, no specially trained personnel or special equipment is required.

The coating is produced by a chemical reaction. The chromate solution reacts with the metal to produce a thin film on the surface. This film is an integral part of the surface. In appearance the original chromate film was yellow iridescent. Later developments led to an olive drab colored film and to a film with a deep bronze hue. In addition, the olive drab film can be dyed to black, red, blue or green. These three basic coatings were widely used during World War II as protective finishes for parts subjected to the extreme corrosive conditions of the South Pacific theatre of operations.

### *Properties of Chromate Films*

In addition to providing excellent corrosion resistance in themselves, the chromate films also provide a firm bond for paint. As such, they have gained further government approvals for materiel that must be painted for color matching or for additional protection from corrosion.

With the end of the war, many manufacturers who had experience with the chromates for military contracts continued using these chemicals for civilian products, both as a final finish as well as a paint base.

The postwar period has developed a further requirement for chromates: to provide a bright chrome-like appearance for zinc and cadmium plate. Special formula variations also had to be developed to meet the demands of the various methods of applying the coatings.

In discussing the use of chromate films to impart a bright, clear coating, it is necessary to understand that the *thickness* of the coating must be con-

trolled so that it is bright and clear in appearance. The clear film is thin and does not show the same degree of interference color as the heavier films. By the same token, the thinner films will not provide the same degree of corrosion protection as the heavier films. Therefore, *the thin, bright, clear films cannot be said to be as protective as the heavier olive drab or bronze colored films.*

This consideration is particularly important today when many manufacturers are simultaneously producting parts for both the government and the civilian markets. Most government specification work calls for at least 100 hours salt spray protection on zinc plate. This requirement can be met with a chromate finish alone only by using one of the basic colored coatings, or one of the dyed coatings. It is possible, however, to provide this degree of corrosion resistance and still produce a clear, bright film by adding a coating of clear lacquer over the bright chromate film. In this case, the chromate film used should produce a medium-heavy coating, with its thickness evidenced by hues of red, blue and green, but not yellow. These colors will be masked by the clear lacquer coating and the result will be a clear, blue-bright surface.

This type of finishing system is rapidly gaining acceptance as a replacement for conventional chrome plating in bright decorative finishing. Its appearance is indistinguishable from chrome plate. Although it is not so hard as chrome plate, its resistance to abrasion is quite adequate for many applications.

From the discussion so far, it will be readily apparent that a wide variety of corrosion protection and appearances are available from the use of the chromate type compounds for finishing zinc and cadmium. In summary, the basic coatings may be either olive drab, yellow iridescent, bronze or clear and bright. In addition, many of these coatings can be rendered black, red, blue or green by use of a simple dye bath. It should be noted that in many cases the corrosion protection and the color produced are a result of the operating conditions.

### *Application to Various Metals*

Chromates can be applied to zinc, cadmium, aluminum, magnesium, copper, brass and bronze in any of their forms, with varying degrees of protection and appearance. At present the large volume uses of chromates are substantially on zinc, since that metal is the most plentiful and lends itself to both corrosion-resistant and decorative products. Zinc is used also quite extensively in government specification work because of its good corrosion resistance, particularly in combination with chromates. Let us consider, therefore, the application of chromates to some of the commercial forms of zinc and what limitations they impose.

#### Zinc Plating

In the case of zinc plate plus a given chromate film, corrosion resistance will vary with plate thickness. This is attributed to the porosity of the zinc plate. For example, after 72 hours of salt spray on zinc and a given bright type chromate, white salt formations vary from general heavy white corrosion products at a thickness of .000175″ of zinc up to only a slight trace of corrosion at a thickness of .0007″ of zinc plate. Therefore, thickness and texture of zinc plate are important when corrosion resistance is a primary factor.

The appearance of chromate finishes on zinc plate can be varied from a highly polished, silvery, clear coating through ranges of blue-brights or iridescent bright, up to the heavy chromate colors of yellow iridescent, bronze or olive drab. By the use of acidified dye solutions, red, blue, black or green films can be produced. The intensity of these dye colors can be varied from light shades to dark colors depending upon the color character of the basic chromate film.

#### Zinc Die Castings

In the case of die-cast zinc, the corrosion resistance provided by a given chromate film will vary with the type of casting alloy. Generally, as the copper content is increased, less corrosion resistance will be provided. For instance, with an olive drab chromate film, at the end of a 243 hour salt spray exposure, Zamak #3 showed no corrosion products, Zamak #5 showed 15% corrosion products, whereas Zamak #2 showed 90% corrosion. The copper content in these alloys ranges from approximately 0.1% in Zamak #3 up to approximately 2.5% in Zamak #2.

There is, however, one important limitation to producing a chromate film on zinc die-castings. The bright type chromates cannot be satisfactorily applied directly to the die-cast surface, due to the alloy content and the crystalline surface structure of the die-cast material itself. However, it is quite practical to zinc plate the die-cast surface and then apply a bright chromate process. Even in this case, though, there is one important caution that should be observed. We have noted that the chromate film may show a blue discoloration on aging. The speed of this discoloration may be reduced by thicker electroplates, or increased by a higher copper content of the die-casting. Therefore, if the zinc plated surface is to be bright chromated for a chrome-like finish, it is necessary to clear lacquer the surface to keep the above discolorations from becoming apparent on aging. This discoloration is attributed to the hexavalent chrome constituent of the chromate film backing down through the pores of the electroplate and reacting with the base metal of the zinc die-cast material. This condition is not noticeable if the die-cast surface is not broken by machining or buffing.

Of course, heavy chromate films either as a base for paints or as a final finish, may be applied directly to the die-casting. These may be yellow iridescent bronze or olive drab and may also be dyed as described above. No "bluing," or discoloration, is apparent from these coatings.

#### Sheet Zinc

Pure sheet zinc can be processed directly with bright-type chromate solutions but the chromate produces only a minimum chemical polish. Thus, the surface should be mechanically buffed. All color effects described above can be imparted to sheet zinc surfaces.

#### Hot-Dip Galvanized

In the case of hot-dipped zinc (galvanized) all color effects and appearances can be provided. However, since chromate films have no covering power in themselves, the spangled appearance of the galvanized surface will always remain apparent and in some cases may be accentuated by the chromate treatment.

### *Corrosion Resistance and Appearance*

As can readily be seen, chromate finishes can be used to produce a wide variety of results. When evaluating the corrosion resistance to be expected from a chromate film alone, remember that clear or bright-type chromates represent the thinnest possible films and consequently provide the least corrosion protection. Colored or thick

chromate films provide more corrosion protection. Although there are many contributing factors that will determine the final corrosion resistance of a chromate film itself, the following table may be considered as a general guide:

| *Appearance* | *Salt Spray hours to white corrosion with chromate protection only* |
|---|---|
| Bright-type chromate | 24 to 100 hours |
| Yellow, bronze or olive drab | 100 to 200 hours |
| Dyed chromates | 75 to 150 hours |

### *Chromate Films As Paint Bases*

As to the use of a chromate film as a base for paint, there are three factors of considerable importance.

First, there is initial adhesion or the sticking of the paint to the chromate surface. Good initial adhesion is accomplished by the theory of molecular adhesion or intimacy of contact. This is in contrast to the mechanical bonding afforded by a crystalline-type prepared surface.

Because there is no appreciable absorption of paint on a chromated surface, approximately 10% less paint is required for a given area to be painted.

Second, good paint adhesion is retained because the base metal is sealed against moisture which penetrates the pores of the paint. In addition, since the chromate is non-porous and gel-like in nature, it effectively stops the formation of metallic soaps and reduces paint peeling on exposure.

Third, the effectiveness of a chromate film is proportional to its thickness; thus, the yellow iridescent, olive drab or bronze types are most effective as compared to the thinner bright-type chromates. Also, because of the gradual leaching of hexavalent chrome from the chromate film, any scratch through the paint film is effectively protected.

### *Method of Application*

Where corrosion resistance is the only factor to consider and appearance is of no importance, the simplest type of processing with chromate solutions may be used. With the zinc or cadmium surface properly cleaned or freshly plated, only one tank for the chromating solution and several rinse tanks need be provided. This type of set-up is satisfactory for processing yellow iridescent, bronze or olive drab coatings. However, if it is necessary to obtain colors such as red, blue, green or black, the process steps must be modified to include the addition of a dye tank and subsequent rinse.

A bright-type chromate coating is produced from the same general set-up, with a bleach tank replacing the dye tank. The bleach is necessary because all properly formulated chromate solutions naturally produce a visible or relatively thick chromate film. To minimize or eliminate this color, some of the film must be removed by a "bleach," or stripping medium, such as phosphoric acid, caustic soda, sodium carbonate, or special formulations thereof.

Space available for hand operations, or limited process stations in automatic equipment, may prohibit the use of all of the above steps. Also, time elements are involved in automatic or continuous-line operations for strip processing. Normally a chromate solution removes zinc at a rate of approximately .00003" to .00004" of thickness in 15 seconds. Some solutions require this immersion time to complete the conversion coating process, and too little or too much time will not give the desired result. Therefore, the formulations must be adjusted to accomplish the desired results and the immersion time must be kept flexible to remove only a minimum amount of zinc or cadmium.

### *How a Chromate Film Performs*

All of these variables account for the necessity for a wide selection of chromate solutions. One formula cannot possibly answer all requirements. Each chromate solution has a special purpose and, naturally, some limitations. A study of what makes a chromate solution "tick" should help prevent some mis-applications and make for more practical usage.

To simplify the explanation of the operation of a chromate bath, it can be said that each solution possesses five basic *characteristics*. These characteristics will vary in amount and relative proportion, depending upon what kind of a job the chromate solution will be required to do. However, since they are not entirely independent in their effect, they cannot always be independently controlled.

#### Film Forming Characteristic

Every chromate solution will produce a chromate film. Normally and within reasonable limits, the more dilute the operating solution the more prevalent is the film forming tendency. Maximum chromate film thickness is in the order of .00002". Even though, in the main, the thickness of the film controls the amount of corrosion resistance, the chemical balance of the film is also important. For instance, the hexavalent chrome cannot be too soluble or the film will not maintain its effectiveness through a normal hot water rinse.

#### Color Factor Characteristic

The chromate film itself is readily identified by its yellow iridescent appearance. However, it is possible to chemically change this color to olive drab or bronze. Normal iridescence is caused by light refraction through the amorphous gel-like film.

#### Chemical Polishing Characteristic

A chromate film cannot be generated without dissolving zinc or the metal being treated, thus the general term "conversion film." The way in which the zinc or cadmium is removed determines whether the metal surface is etched or chemically polished. The polishing or smoothing action provides the degree of reflectivity, or brightness, to the surface. Smooth surfaces reflect a minimum degree of iridescence for thin chromate surfaces (bright-type) and maximum iridescence for heavy chromate films (olive drab to bronze types).

The above three characteristics are the most fundamental and influential in the formation of a chromate film. However, they can be controlled to varying degrees by the action of two other characteristics. These two characteristics allow the user to select any of a variety of appearances in the chromate film and permit satisfactory performance under the various operating conditions described earlier.

#### Film Inhibiting Characteristic

Since all properly formulated chromate solutions will form a chromate film that is apparent by color, and since thin chromate films reflects minimum color, this fourth characteristic must be a prevalent one in the chromate solution when bright-type chromate films are required.

#### Self-Bleaching Characteristic

This is the tendency of the chromate film to be reduced in thickness by the action of the drag-out chromate solution retained on the surface of the wet film. Most chromate solutions can be formulated to contain a varying degree of this characteristic as an aid to controlling the intensity of the color. Its usefulness is of greatest value in auto-

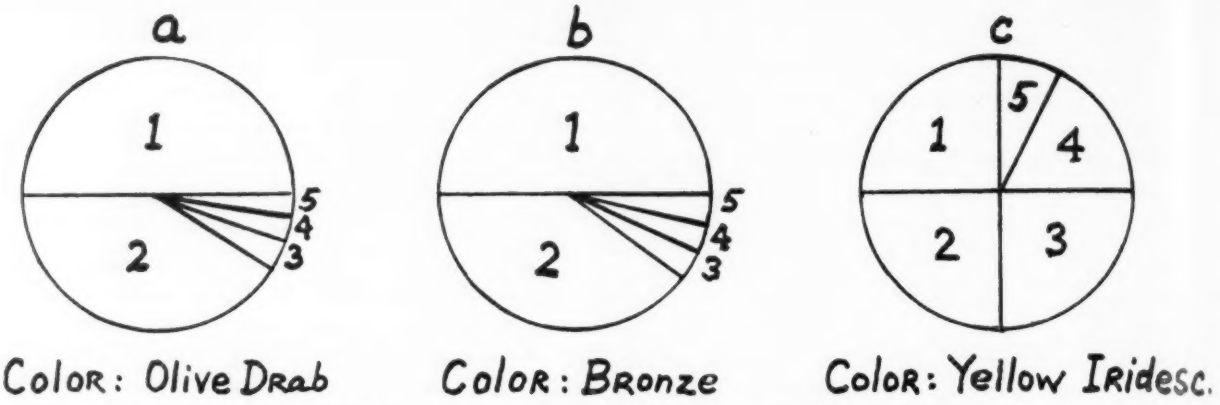



Figure 1. Graphic pie charts representing the principles of chromate bath formulation.

matic installations where there is an appreciable indexing time between process stations. The combination of the Film Inhibiting and Self-Bleaching characteristics makes possible a non-bleached bright-type chromate treatment, better known as a "one-dip bright."

### *Formulation of Chromate Baths*

Now, let us look at a graphic representation of how the five characteristics are put to work in typical chromate solutions. The pie charts to follow are not to be taken as quantitative measures of the chemical constituents of the chromate solutions, but rather as approximate values of these five basic characteristics.

The numbers in the pie sections of the charts correspond to the five major characteristics as follows:

1. Film Forming
2. Color Factor
3. Chemical Polishing
4. Film Inhibiting
5. Self-Bleaching

In Figure I is illustrated two chromate solutions, "a" and "b" which are qualitatively identical. Both are heavy-type chromate films of maximum corrosion resistance and color intensity. They differ only in color. Characteristics #3, #4, and #5 are of no consequence as compared to #1 Film Forming and #2 Color Factor. The color characteristics in these two chromates are of equal intensity but of *different chemical balance* to produce the difference in color. The normal corrosion resistance of these films will be between 100 and 200 Salt Spray hours to white salts. If all conditions are favorable, 500 Salt Spray hours can be achieved.

Now let's consider a different formulation, such as "c" in Figure 1. Obviously #1 characteristic (Film Forming) has been reduced by the inclusion of #4 (Film Inhibiting) and #5 (Self-Bleaching) characteristics. Consequently, #2 (Color Factor) is correspondingly reduced. The chromate film produced is relatively thinner and brighter because the chromate solution has a more prevalent portion of #3 Chemical Polishing. This type of formulation obviously represents a rather flexible chromate solution. As it is represented in the above chart, it will provide good corrosion resistance and brilliance to the appearance of a treated part. Finally, the color will not be as intense as that shown in the "a" and "b" formulations. The corrosion resistance of this film will be somewhat in excess of 100 hours salt spray.

However, if this "c" type chromate bath were diluted, the effects of the characteristics #3, #4 and #5 would be diminished. The pie chart appearance would then approach that of "a" and "b", which produce a heavier, more protective and darker film.

To complete the discussion of the flexibility of this "c" chromate bath, let's see what else can be done with it. It produces a relatively thin chromate film on the metal surface, thus can be used as a bright-type film since it has all the fundamental characteristics necessary, except that it produces too much film thickness and, consequently, too much color.

If the chromated surface is "bleached," which means partially stripping the chromate film from the metal surface while it is still wet, its thickness and color are reduced. In effect, this external chemical treatment alters the graphic representation of what chromate bath "c" will do (see Figure 2d).

The resulting appearance is a blue, bright-type appearance which will reflect some degree of iridescence on large flat surfaces. Its corrosion resis-

Figure 2. Chromate bath formulation schemes to meet varying requirements and processing schedules.

tance on zinc plate is in the order of 48 to 72 hours salt spray, whereas before bleaching it was in the order of something better than 100 hours salt spray.

Many industrial applications require a less iridescent, brighter coating *particularly on large parts with flat surface areas*. Here a lesser degree of corrosion resistance must be accepted. This requires still a further modification in the formulation of the chromate solution to produce a still thinner film on the zinc plated surface. This is accomplished by again adjusting the chemical balance of the chromate solution formulation so that the film produced is thinner and under normal operation can be easily bleached for a further reduction in film thickness. Corrosion resistance of a film such as this will run 24 to 48 hours salt spray. If conditions of plate thickness and texture are favorable, it can be made to approach 72 hours salt spray.

The modification in formulation of the chromate solution would then look like Figure 2e. It will be observed that #4 Film Inhibitor has been increased, so that less film generates, thus reducing that which must be removed by bleaching as compared to the case of chromate bath 1c. Observe that segments #1 and #2 are smaller, denoting less film.

### *Bath Variations Required by Processing Limitations*

Now, as mentioned earlier, equipment limitations sometimes prohibit the use of an extra bleaching step. For instance, let's consider an automatic zinc plating machine in which it is desired to bright chromate treat the zinc plated parts. Only four stations after the plating tank are available. Also, let's assume that the immersion time at each station is 15 seconds and the transfer time between stations is 15 seconds.

Here again, a modification of the chromate solution formulation is required. The qualitative "pie" chart now takes on quite a different aspect, since #1 Film Forming must be kept to a minimum by the action of the chromating solution itself. See Figure 2f. In this formulation a little more of #4 Film Inhibiting is put to work. However, the full effect of #5 Self-Bleaching can be utilized during the transfer time from the chromate solution to the following rinse. The remaining color after the rinse is so slight that it can be bleached out entirely by a final hot water rinse of approximately 180°F. The corrosion resistance of the film is approximately equal to that produced by bleaching the chromate film produced in a bath such as 2e.

Further examples could be shown to illustrate various other modifications. Bright-type, one-dip chromates are being applied to zinc plate in continuous strip mill application with zinc thickness as low as .00003". Of course, it is obvious that the chromate under these conditions cannot do any appreciable amount of chemical polishing, or else all the zinc would be removed. For conditions such as this, the zinc plate has to be deposited in a relatively bright state by the use of organics in the plating solution. The chromate solution reacts with the zinc plate only to the degree that the reaction produces a very thin chromate film. The color and film thickness are controlled by #4 Film Inhibitor to a much greater degree than shown in chromate bath 2f. The #3 Chemical Polish action is practically eliminated. Of course, the protective quality of a chromate film of this type will be low, at best in the vicinity of 24 hours salt spray. Regardless of this low corrosion resistance, this chromate when used as a base for paint, has shown unusually good results in outdoor exposure tests in Florida.

As mentioned at the beginning of this article, chromates are being developed for use on metals other than zinc and cadmium. Chromate treatments are now available for aluminum, copper, brass and bronze. In some respects chromate solutions for aluminum are easier to use, and more flexible, than the solutions for zinc and cadmium. Varied methods of processing are being developed as problems are presented by industry, and corrosion resistance obtained compares very favorably with the more costly anodizing methods. There is no longer any doubt that chromates are an established and important factor in the field of protective and decorative finishes for both military and civilian products.

Figure 3. Car trim, with a .0003" zinc plate plus a bleached chromate treatment and clear lacquer resembles closely chromium plating. This finish has over 200 hour salt spray life.

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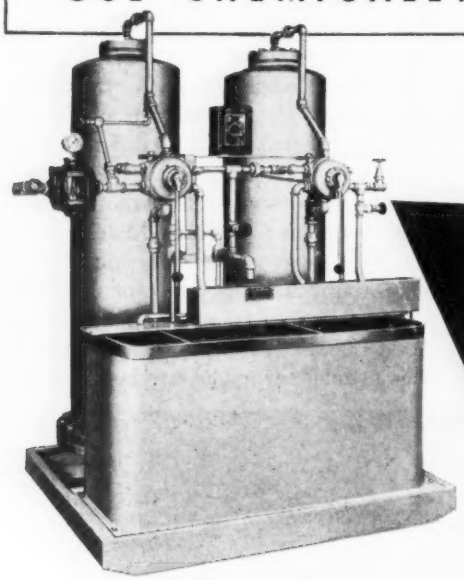

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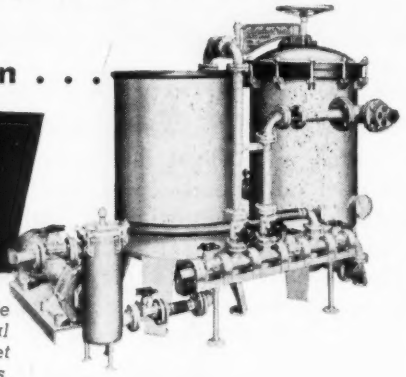

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## PLATING IN THE RE-ARMAMENT PROGRAM

(*Continued from page 88*)

performed on the sheet so prepared. Another procedure for preparing a starting sheet involves the use of photoengraving. A related application is the electroforming of metal sheets of very fine and controlled porosity for use as gas diffusion plates.

The electroforming of molds for cosmetic gloves for amputees is an application for which we all hope there will be little need, but it is well to recall the exceptionally fine results which have been achieved in this difficult art by the use of electroforming methods. (See Figure 2.)

As can be seen from this brief summary, the applications of plating in military and related items are innumerable. In very many items plating is sufficiently important to merit specific allocation of critical materials for the purpose. To do this it is necessary that other items be curtailed or eliminated. The total amount of metal that will be plated will not be much different from the total plated in peace-time (its overall total may even be greater than under normal operation) but the items to be plated will be those that the country needs, and the metals used will be determined by their availability and need throughout all of industry. The following series of articles will demonstrate what is being done in a few important fields and will serve to illustrate the ingenuity and skill with which the industry has responded to past and present needs. As new needs develop there is no doubt that the platers will respond with equal ingenuity and skill to meet them, and proceed to plate what is required by the nation.

## FINISHING ARMY ORDNANCE MATERIEL

(*Continued from page 91*)

operation of this type since the slightest contamination due to suspended matter such as sulphates, chromates or other insolubles causes erratic plating. By using forced agitation, an extremely smooth deposit is assured and in some cases this may even eliminate the final grinding operation, or at least reduce the amount of metal to be removed.

### Anodizing of Aluminum

Aluminum as used in Ordnance materiel is subjected mainly to conditions of corrosion rather than abrasion. This corrosion environment is such that it is

necessary to go to the extreme of a protective system. The electrochemical finish found most desirable to decrease corrosion under combat conditions is the conventional anodize and 2-coat paint system. The coatings formed on aluminum alloys by anodic treatment constitute the principle method of protection of aluminum surface. Ordnance makes extended use of practically all the aluminum alloys available commercially. It has been the experience that good paint adhesion and thus corrosion protection is secured with practically all aluminum alloys.

A typical case is the bipod (see Fig. 8), which is part of the Recoilless Rifle, and which is formed from 14 S-T aluminum. This assembly is subjected to severe handling and the usual rough treatment which results from combat operations. It is necessary, since the remainder of the weapon is made of steel, to eliminate the galvanic couple which would form where mating surfaces are encountered. This condition is eliminated by using a dielectric paste-like compound, or tape, between components, and it is found to be particularly effective for this purpose. The paint system requires that the prime coat of the anodized component be a zinc chromate primer, subsequently coated with the conventional olive drab.

The solutions and procedure used for anodizing for Ordnance is the chromic acid anodizing system.

This system of anodizing develops a thick (0.0002" to 0.0005") dense, adherent coating of aluminum oxide on the surface. The coating is sealed with a hot dichromate dip, dried and painted, as previously indicated.

The above examples are but a few of the many applications of metal finishes on Ordnance items. The complete range of applications runs the whole gamut of surface preservation processes, and contributes materially to the efficiency and dependability of the Army's field weapons.

## PLATING'S ROLE IN NAVAL ORDNANCE

(*Continued from page* 95)

above this precipitate is then siphoned off and replaced by an equal amount of clean water. The resultant solution is thoroughly stirred to wash the precipitate, and after settling, the clear solution is again siphoned off. This washing procedure is repeated five times to assure the removal of impurities such as sodium hydroxide, nitrates and ammonia.


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106A

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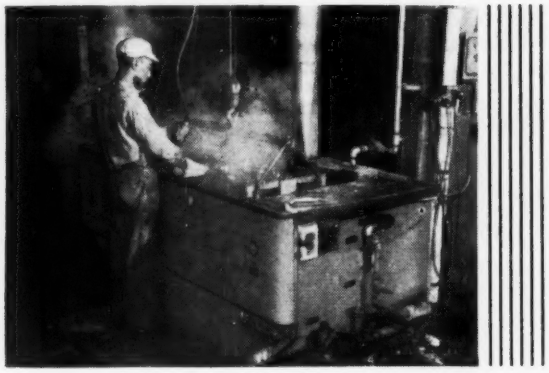
**Ordinary cleaning methods and machines are apt to let the chips from metal forming operations stay put! Degreasers do a fine job on oils and greases, but fall down on the chips and solid dirt. Spray-type cleaning machines, particularly on masses of bulk small parts, cannot do a good job of chip removal, because it is impossible for the sprays to reach all surfaces of each individual part.**

**But you can clean and remove chips in one operation . . .**



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**using the cleaners best adapted to the dirts to be removed, insure thorough removal of chips and solid dirt because of the thorough scouring action provided by the mechanical cleaning action of the machines. Parts are moved up and down in the cleaning solution 54 times a minute, imparting a vigorous turbulent scouring action in addition to the chemical cleaning effects of the solution. This scouring action takes place on every surface of every part, even in the center of the load. And you get completely automatic operation, in which man-power is needed only for loading and unloading.**

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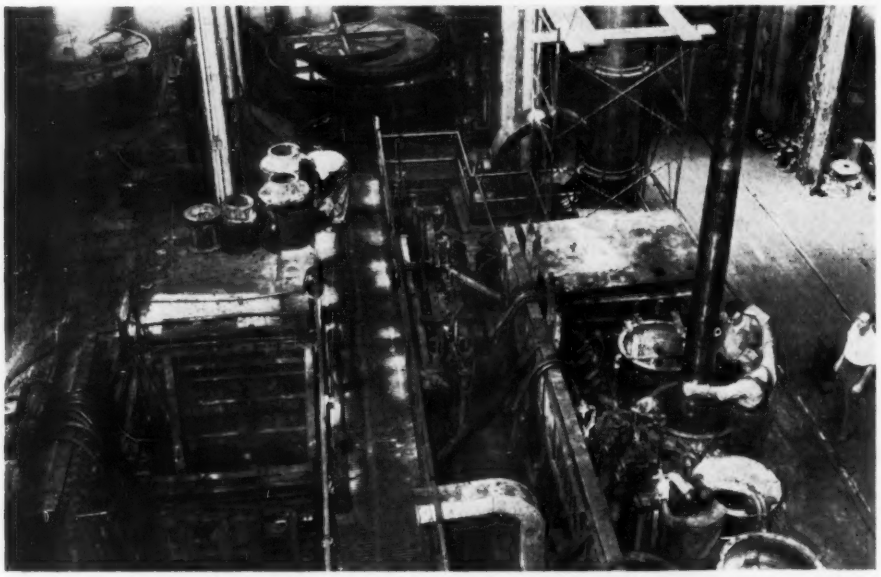


**Figure 4. Gun barrel plating section - polishing and plating shop.**

After the washing operations are completed the precipitate is dried to a paste by means of the steam coils in the tank, care being taken to avoid drying to a hard cake, because it is difficult to remove from the tank. The resultant paste is stored in earthenware crocks and when needed, is added to the plating baths to replenish the metal content. It is first analyzed to determine the cadmium content as a basis for calculating additions. The paste is dissolved in sodium cyanide solution before adding it to the baths, care being taken to avoid using an excess of the cyanide.

Experience has shown that after adding this cadmium hydroxide paste to the plating bath, the deposit is less bright for about an hour or so, making it sometimes necessary to add a small amount of brightener. During the past few years many hundreds of pounds of cadmium have been salvaged in this manner.

### *Summary*

The Polishing and Plating Shop has earned an enviable record in maintaining war-time production levels with no sacrifice to quality. With the finest equipment available and with the services of mechanics of long experience in the various trades employed, this shop has the reputation of performing every job which has been assigned to it. The key to the potential of this shop is the capacity of its generators — six 10,000 ampere — sufficient to perform any plating job. The size of its plating tanks is also important in fulfilling its mission as an integral part of the Naval Gun Factory. Facilities are available to process a great many different details simultaneously. No special emphasis is placed on any one type of work.

## ELECTROFORMING MILITARY COMPONENTS

(*Continued from page* 97)

There is a great deal of mechanical know-how needed for racking and shielding. The application of agitation to speed up the usually slow process is a necessity.

Electroforming does have one main difference from plating, and that is adhesion. Normally plating must adhere firmly, whereas the electroformed article must be removed from the surface on which it is deposited. Some of the separation treatments have been discussed. The passivation of nickel surfaces or the weakly adhering silver im-

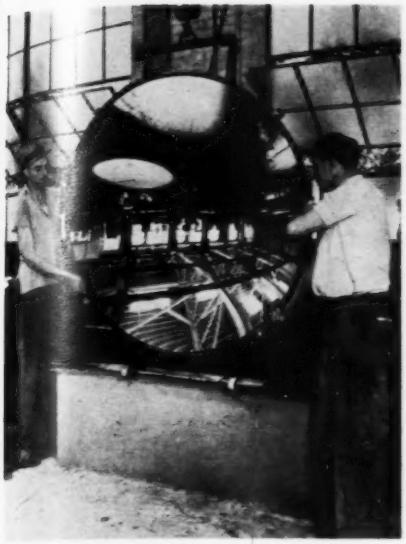
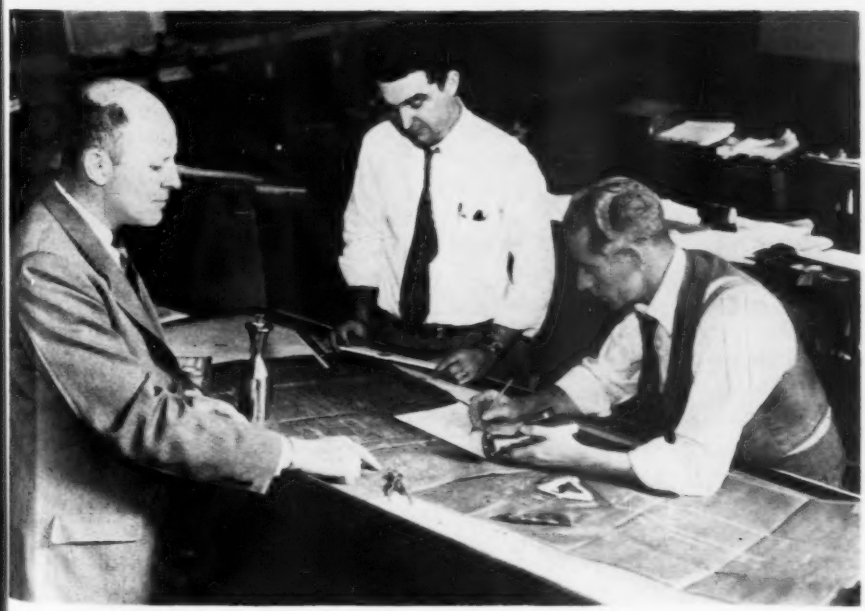


Figure 2. Many precision searchlight reflectors were made during World War II by the electroforming process. Note the high reflectivity of this reflector after a rhodium flash plating.

mersion coatings have been reported many times. The practical application of these methods are so diversified that they vary with the jobs themselves. It is only by actual experience that one can decide on the best way of getting the strength or bond necessary to hold the electrodeposition on the mandrel sufficiently snug so that it will not separate during the electroforming operation, but will release when desired.

The unlimited possibilities of electroforming are being further increased by a considerable amount of work on the electroforming of such elements as tungsten, molybdenum, aluminum and titanium. In addition, considerable work is being done on the electroform-

Figure 3. Electroforming involves factors that are principally mechanical, similar to the planning for any other type of metal forming operation.



ing of alloys, which will widen the scope of electroforming and enable it to keep pace with the high temperature, high strength materials which are required in the new rocket industry.

In summarizing, electroforming is an excellent means of producing precision parts for many services. With the basic facts before one, the evaluation of electroforming for a particular requirement is not difficult.

Electroforming is economically feasible for the parts requiring fine finishes and close tolerance. It is not generally able to compete with other forming operation for run-of-the-mill parts.

Electroforming is, despite its use of plating solutions, essentially a mechanical operation and should be investigated with that in mind.

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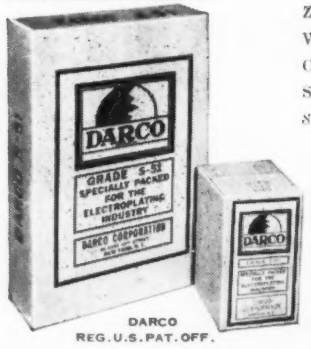


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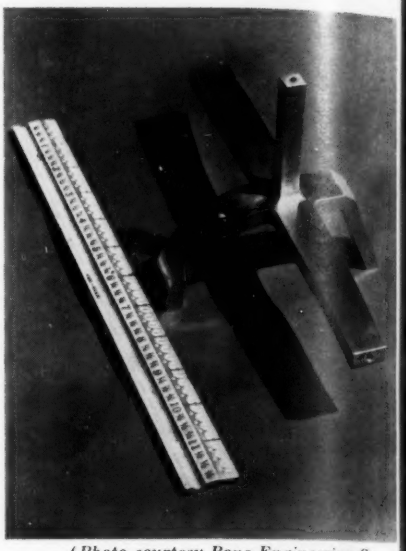
## MILITARY APPLICATIONS OF ELECTROFORMING

(*Continued from page* 99)

finish of the electroformed part and also greatly affects its cost. A wide variety of materials can be used as matrices such as wood, plastics, rubber, plaster of Paris, fusible alloys, aluminum, zinc, steel, and brass. They can be divided into two main groups — the permanent type which can be used for repeated runs, and the expendable type. The permanent type group includes steel, brass, nickel, and stainless steel. The expendable group can be subdivided into dissolvable metals such as zinc and aluminum, and fusible materials such as lead alloys and waxes.

In designing a matrix, one must give careful consideration to favoring the electroforming process wherever possible in every detail of construction. Rounded contours are desirable where ever possible, sharp deep recesses should be avoided, slight tapers are advantageous where permanent cores must be withdrawn, and junction surfaces between sections of the core must be tight so that no visible crack is evident.

Matrices can be formed in several ways depending on the quantity, tolerances, shape, etc. Die, slush, and permanent mold castings, hubbing, and machining comprise the more common methods. When the number of parts is sufficiently large to justify the cost of a mold, cast matrices are the most economical. The highest degree of dimensional accuracy and surface finish is obtained in a die cast mold. Cast matrices are always of the expendable type and may be wax, plastic, zinc, aluminum, or fusible lead alloy.

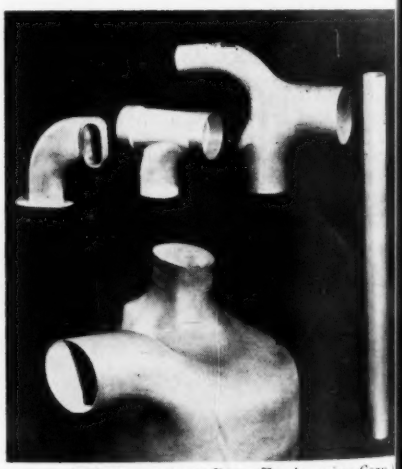


(*Photo courtesy Bone Engineering Corp.*)

**Figure 3. Electroformed Turnstile Junction — Special radar waveguide fitting made in one piece over expendable metal mandrel. Inside dimensions accurate to ± .001" with a 5 microinch finish. Lined with .0005" silver.**

If the required number of electroformed parts is compartively small, usually less than one hundred, machining or hubbing of the cores is most economical since with a die the amortization cost per unit would be prohibitive. Machining and hubbing can be used on both the expendable and permanent type of core materials.

The next step is the proper mounting of the matrix for suspension in the plating bath. This must be done with a view towards securing the most uniform metal distribution possible and may include the mounting of a target anode to achieve sufficient metal deposition in some recessed portion. Guard wires are often attached to prevent undue build-up on edges or projections. Insulating shields are sometimes employed to lower the current



(*Photo courtesy Bone Engineering Corp.*)

**Figure 4. Electroformed Nickel Aircraft Duct Fittings.**

density in projecting surfaces or to raise it in recessed areas. Areas of the core which must be protected from metal deposition are stopped off with insulated caps or lacquer at this time.

### Treatment for Conductivity

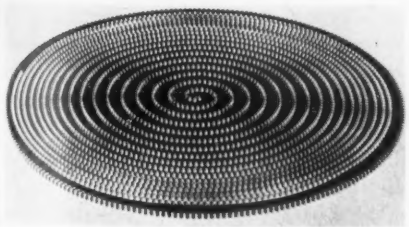
Treatment of the matrix before it is

*(Photo courtesy U. S. Rubber Co., Norwalk, Conn.)*

**Figure 5. Surface Roughness Gauge. Electroforming here provides an inexpensive, simple means of accurately reproducing 18 machined, ground, and lapped surfaces. Used extensively throughout industry by design engineers and in the machine shop to specify and control metal surfacing operations.**

placed in the plating bath is next in order. This step is necessary to insure satisfactory and complete removal of the core material after electroforming, or to provide an electrically conductive surface on a non-conducting matrix, whether it be of the expendable or the permanent type. All treatments consist in the application of films which can be divided into four groups:

1. Metal Films — A metal film such as silver is applied to a non-metallic surface by either chemical reduction or metal evaporation.
2. Chemical Films — An oxide or



*(Photo courtesy Bone Engineering Corp., Glendale, Calif.*

**Figure 6. Computing Pin Cam. Used as a component part of fire control equipment for Naval gun batteries. Electroforming has proved the most satisfactory method of duplicating the quality and high degree of precision required on these parts.**

other metal compound is formed on the core surface to prevent adhesion of the electrodeposited metal.

3. Fusible-metal films — These are used on permanent type matrices only and when heated above their melting point after electroforming provide clearance for easy withdrawal of the matrix. Plated tin or lead is used for this purpose in thickness from 0.0001 to 0.001 inch. Allowance is made in the core dimensions for the thickness of the fusible metal film.

4. Organic films — Clear lacquer, metallic lacquer, rubber and carbon films are suitable for use on either metallic or nonconducting matrices. On the non-conducting matrix, the film provides not only the separating medium but the conducting surface for plating as well.

### Electroforming

After the core has been mounted and properly treated, it is ready for the actual electroforming operation. This part of the process is essentially modern electroplating without, of course, the preparatory cleaning cycle. Agitation and constant filtration are required for quality results in most cases. Wetting agents are generally employed to eliminate pitting. Since the work usually remains in the bath for a matter of days, it becomes imperative to inspect the parts at regular intervals for replacement of built-up guard wires, smoothing unduly rough areas, or rotation of the part to equalize plate distribution as necessary. On the average, these maintenance operations are not required oftener than once every two days.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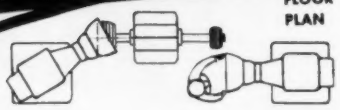

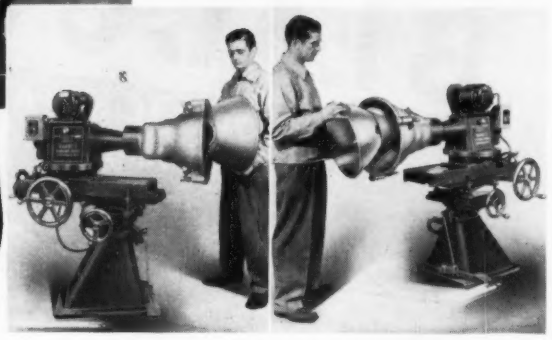

*Above: - Vanott V-1 Standard Single Spindle Machine.*

*Right: - Chucks designed to hold these 18" dia. floodlight reflectors being manufactured by the General Electric Company of West Lynn, Mass. Buffs large end of bell in first operation, small end in second operation as shown on far right. The drawing illustrates how one operator handles two machines.*

● VANOTT single spindle polishing and buffing machines are designed for maximum adaptability to increase your production and reduce labor costs in polishing products with either plane or curved surfaces.

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### Separation

When the specified thickness of metals has been deposited, the object is removed from the electroforming bath and is ready for the separation step. This usually involves a simple lathe or band saw operation to free the edges so that the core can be melted out, dissolved out, or removed intact from the electroform, as the case may be. The next operation comprises the removal of any residual core material from the inside surface of the electroformed part and the final machining of edges or outside surface as required. Where the increased rigidity of section supplied by the core is necessary for precise machining of the outside surface, the core is removed after machining.

### *Conclusion*

It can be seen from the applications described earlier that electroforming is playing a very active and important part in our present military program.

Many other potential applications of a military nature, which for security reasons cannot be described here, are currently under development in various locations throughout the country. The *Atomic Energy Commission* utilizes electroforming methods in several instances throughout their program.

An active program, sponsored by the Government, has been under way for some time to develop a method of electroforming aluminum parts.

There is every indication that, as the current military program develops and expands, there will be a correspondingly wider application of electroforming methods throughout every branch of the service.

## HARD CHROME PLATING

(*Continued from page* 102)

delay which would have been required for delivery of a new spindle.

Since the last war, a new chromium plating bath has been developed which has several advantages for hard chromium plating. Its cathode efficiencies are 1/5 to ½ again greater than those of the ordinary chromic acid-sulfate baths. This, coupled with its wider bright plate range, makes possible substantial savings in plating time.

Another advantage is its superior leveling action. Because this bath levels over minor surface irregularities, less final grinding of the deposit is required. The plater can therefore deposit a thinner deposit than heretofore.

### *Obtaining Defense Hard Chrome Work*

Frequently manufacturers of defense equipment and some governmental agencies seek qualified plating plants to do contract hard chromium plating. Naturally they are looking for plants that are experienced. Any plant that is qualified should make the fact known. Plants which are not doing hard plating are not in so advantageous a position, but with the proper assistance, many plants which are not currently doing hard plating can carry out successful and profitable hard chromium plating operations.

## PHOSPHATE COATINGS

(*Continued from page* 108)

to tin in its ability to adsorb and hold oil and also because it is accompanied by an etch pattern in the basis metal which is ideal for bearing surfaces.

### *Improving Drawing and Extrusion*

The great pressures that are required in most forming operations can cause destructive frictional contact between die and metal, resulting in excessive breakage or unduly short die life. Recently it was discovered that by phosphate coating steel prior to working it, drawing, extrusion and other forming operations could be greatly improved. Of great interest and importance to industry is the fact that a protective phosphate coating makes possible the cold extrusion of steel.

Getting cold steel to flow depends on

Figure 3. Drawing phosphate coated wire.

some unique characteristics of this coating. Its non-metallic phosphate crystals are physically and chemically adapted to acquire a strongly adsorbed lubricant. The combination of adherent phosphate coating and adsorbed lubricating film possesses a low coefficient of friction while maintaining its integrity under extremely high deforming pressures.

The phosphate coatings used for drawing improvement are at present always of the zinc phosphate type. They are applied by immersion processes or in continuous spray washers. By variation of time, temperature, solution composition, etc., coatings of weights from 150 to 3000 mg./sq. ft. are applied depending on the requirements of the job.

When used in conjunction with a suitable lubricant, the coating reduces friction under conditions of low, medium, or high de-forming forces encountered in such typical operations as: cold extrusion of steel; cold shaping, deep drawing (tubes, cartridge cases, shells, etc.); stamping; drawing of wire and tubing; ironing; necking; nosing; and upsetting.

## HEAVY SILVER PLATING

(*Continued from page* 104)

when enough soil or rust to hold moisture is left on the surface. On the other hand, a bond strength that may be rated as only fair after plating may get a rating of perfect after heating.

### *Plating Practice*

The preparation of the steel for plating follows standard practice, such as


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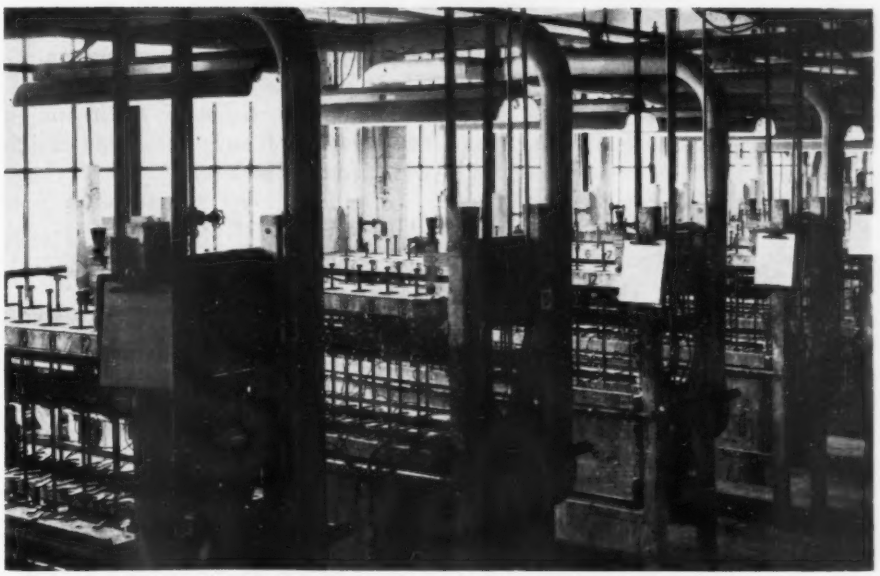

Figure 5. View in the plating department at Oneida, showing the special set-up for bearing plating.

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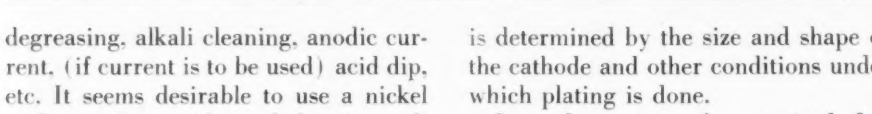


degreasing, alkali cleaning, anodic current, (if current is to be used) acid dip, etc. It seems desirable to use a nickel strike, a silver strike and then into silver solution. Good rinsing between dips is very important.

In order to deposit this heavy coating of silver in a reasonable period of time, it is desirable to use a high concentration of silver. It is not unusual to plate at current densities as high as 100 a.s.f., which makes it desirable to use a silver solution with about 15 oz. silver per gallon and the same amount of free cyanide, at a temperature of about 100°F., with lots of agitation. All of these factors are important in doing high speed plating, and their use is determined by the size and shape of the cathode and other conditions under which plating is done.

In order to get the required fine grain structure of deposit, it is necessary to plate near the maximum current density that can be used for the set of plating conditions under which plating is done.

It seems desirable to use a brightener in the silver solution, as this aids in getting a smooth deposit of silver.

The pictures of different bearings plated for various bearing manufacturers during the last war by *Oneida Ltd.* will give a good idea of how important heavy silver plating is to military applications.

## SHOP PROBLEMS

### Blistered Cadmium Plating

*Question:* We are sending you some samples of our cadmium plated work with which we are having blistering trouble. Our treatment includes vapor degreasing, pickling, sand rolling, soak cleaning, rinsing, pickling dip, rinse, and plate. We would appreciate any comments on how we can overcome this problem.

H. J. A.

*Answer:* In each case where a blister could be lifted from the surface by means of a sharp knife blade there was found a black smut underneath the blistered area. The smut resembled carbon or graphite, and was non-adherent to the steel surface.

It is suggested that the preliminary cleaning be done in an emulsion solvent cleaner, with agitation, rather than in the vapor degreaser. Following this, the parts should then be soak cleaned in an alkaline cleaner, rinsed, sand rolled, rinsed, again alkaline cleaned (preferably anodic), rinsed, dipped in 10% hydrochloric acid, rinsed, and plated. Normally the sand rolling would be expected to remove any adherent smut left over from your vapor degreasing operation, and it is suggested that your sand rolling set-up be checked to see that the sand is not contaminated with oil or other dirty material. Parts going into the rolling operation must first be thoroughly cleaned of oily films, otherwise the rolling operation simply smears the films over the surface of the parts. The second alkaline clean after rolling is necessary to take care of this eventuality.

### Zinc Bath Makeup

*Question:* In the method for making up zinc plating solutions entirely from zinc anodes, how much time is needed to dissolve the proper amount of zinc? We are looking for 4 oz./gal. of zinc metal, and want to know how long the process should be left going before we begin to make analyses for zinc content.

F. T. P.

*Answer:* Theoretically the 4 oz./gal. of zinc metal should require approximately 9,400 ampere-hours per 100 gallons of solution. However, due to

the fact that a small amount of the zinc which is dissolving also plates out on the cathodes, it usually requires about 10,000 or more ampere-hours to build up the bath to the required concentration. Analyses for zinc metal can be started when this amount of electrolysis has been completed. If the *cathode* current density is kept above 70 a.s.f., and the temperature is kept at room temperature there will be very little of the zinc plated out on the cathodes. The cathode current density is adjusted by adjusting the total cathode area, using an *anode* current density of about 15 a.s.f. Using carbon or cast iron anodes also helps prevent deposition of the zinc on the cathodes.

### Immersion Tinning of Aluminum

*Question:* We would like to investigate the possibility of coating some aluminum alloy pistons with tin by the immersion process, and would appreciate your sending us any information that you have on such a process.

C. R. C.

*Answer:* This process was described in detail in METAL FINISHING, January 1938. Briefly, the method consists of immersing the cleaned pistons in a 6 oz./gal. solution of Sodium Stannate for 3-5 minutes at 180°F. The important things to control are the temperature, the tin content, (0.8-2.15 oz./gal. of tin metal) an dto keep the free alkali content less than 1.25 oz./gal.

There are a number of important details in the cleaning procedure before tinning, and we suggest that you consult the above reference for complete details.

### Aluminum Bus Bars

*Question:* We have heard that it is possible to use aluminum for bus bars in the plating room. As we are having trouble locating copper for this purpose, we would appreciate your giving us any information you have on the use of aluminum for this purpose.

S. H.

*Answer:* Aluminum makes a perfectly good bus bar material. You should remember, however, that the conductivity of aluminum is less than that of copper, so that a total area approximately 60% greater is needed to carry a given current. There is some difficulty in making good low-resistance joints with aluminum, but if the joint areas are thoroughly cleaned of oxide and firmly clamped and coated with a corrosion resistant material there should be no trouble on that account.

### Electrolytic Descaling Process

*Question:* We understand that the patents on the Bullard-Dunn electrolytic descaling process have now expired and that the process can now be used without obtaining any license or paying any royalties. Can you give us any information on this?

R. W. A.

*Answer:* Patent 1917022 covering the electrolytic descaling method developed by the Bullard-Dunn Co. expired some time last fall (1950). We have been informed that the Bullard-Dunn Division of the Bullard Co. has been discontinued and no longer handles the process.

### Substitute for Bright Brass Finish

*Question:* We have the problem of finding a substitute finish for bright brass for steel handbag frames, as we are no longer permitted to use bright nickel undercoatings. Can you suggest how this can be done without using any nickel?

W. K.

*Answer:* Assuming that you can still use brass plating for this purpose, the most obvious solution to the problem is a heavier brass plate, buffed bright. Another suggestion is bright copper followed by a flash of brass. A third possibility is a bright zinc plate followed by flash brass plating. The last method will probably be free from restrictions for a longer time than the others. Of course there are a number of organic finishes that could be used also.


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# Recent Developments

New Methods, Materials and Equipment for the Metal Finishing Industries

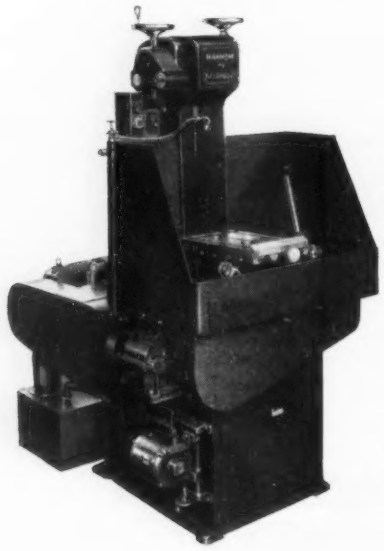
### Abrasive Belt Grinder

*Hammond Machinery Builders, Inc., Dept. MF, 1601 Douglas Ave., Kalamazoo, Mich.*

Hammond has added to its abrasive belt platen grinder line a new heavy duty 8" Wet Abrasive Belt Grinder known as Model V8-WP. It features a new patented power reciprocating table with tilting workholder, and a water-cooled belt platen (patent pending). The machine is designed for production finishing and surfacing parts of ferrous, ceramic, plastic, and thin ferrous parts. Thin sectioned parts can be finished without danger of distortion.

The power reciprocating table travels on hardened steel ball bearing ways and is driven by a "V" belt from a small motor to a reducing gear and crank disc. Table travel is adjustable from 0" to 8", and the stroke speed back and forth across the abrasive belt can be varied to suit the work being done. Construction of the tilting workholder makes it effortless and easy to bring work to loading, unloading and grinding positions.

Features of the water cooled platen make it possible for the downward pull of the abrasive belt to create a continuous film of coolant between the back of the belt and entire face of the plate. The water cooled platen eliminates distortion of both work and platen usually caused by heat.



The self-contained coolant system employs 2 coolant tanks with a combined capacity of 35 gals. The Hammond Model V8-WP also can be equipped with a plain table or manual reciprocating table, and for water main connection instead of with self-contained pump and tank unit. For complete information and descriptive literature write to the above address.

### Lead-Covered Copper Heating Coils

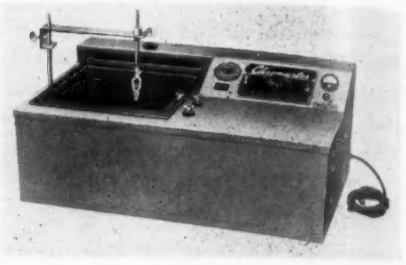
*Knapp Mills Inc., Dept. MF, 121 Broad St., New York 4, N. Y.*

This firm announces a line of lead-coated copper coils for heating or cooling highly corrosive acid solutions. These coils are claimed to give long un-interrupted service life under severe corrosive conditions. The inner copper lining eliminates any corrosion by the steam, yet gives good heat transfer to the outer lead sheating. These coils may be used up to 150 p.s.i. pressures. The regular lead coating thickness over the copper tubing is 3/32" to ½". Complete information on these coils may be obtained by writing to the above address.

### Industrial Hard Chrome Unit

*Ward Leonard Electric Co., Industrial Chrome Div., Dept. MF, South St., Mt. Vernon, N. Y.*

Model A-50 Chromaster is the latest addition to Ward Leonard's new line of industrial hard chrome plating units. In combination with Chromasol solution, the Model A-50 Chromaster affords metal working and other industries with a new production tool for precision industrial hard chrome plating directly on cutting tools and wear parts. After only 3 minutes plating time, the average life of cutting tools and wear parts can be increased



2 to 10 times with this new simplified process, it is claimed.

This new bench-mounted plating unit is compact, self-contained and easy to operate. It has a capacity for hard chrome plating metal surfaces totaling 25 sq. in. max. at the recommended current density of 2 amps. per sq. in.

Model A-50 Chromaster consists essentially of a built-in selenium rectifier power supply, rectangular plating tank and instrument panel. Current control is by means of a continuously adjustable autotransformer. Cabinet measures only 14"H. x 32"W. x 19"D. Unit operates from single phase 110-120 volts A.C. 60 cy.

Chromasol, a non-critical, economical plating solution developed for use in Chromaster plating units, operates at room temperature. It is shipped as a concentrated liquid ready for dilution with water prior to use. The hard chrome deposit can be applied directly on industrial steels, cast iron and most non-ferrous metals.

### Dry Acid Cleaner

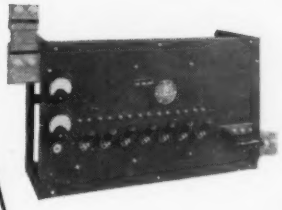
*Wyandotte Chemicals Corp., Dept. MF, Wyandotte, Mich.*

This firm announces the re-formulation of a pickling and descaling compound which may be used in water solutions as a replacement for liquid acids. Readily available, Wyandotte A.E. is non-hazardous, easy to handle, and gives off no obnoxious fumes, it is claimed. In recent tests, the re-formulated product is said to have shown remarkably increased efficiency.

Other advantages claimed for Wyandotte A.E. are controlled foaming characteristics, freedom from dust,

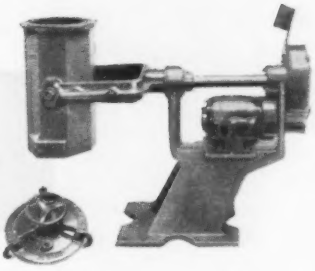
# CROWN Equipment

Model 815 Selenium Rectifier

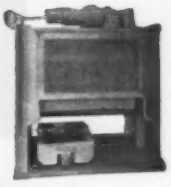


Crown Rheostat with Cut Out Switch

Crown Rheostat

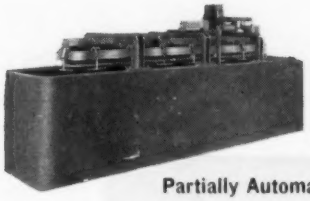


Ball Burnisher

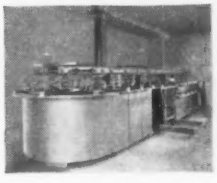


Crown Tumble Finishing Machines

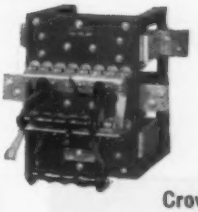
Centrifugal Drier



Partially Automatic

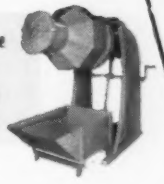


Fully Automatic Plating Machines



Crown Reversing Switch

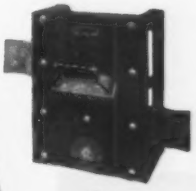
Bench Type Utility Plater



Bottle Type Tumble Finishing Machine

Tilting Type Tumbler

Rinsing and Drying Unit



Crown Disconnect Switch

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### Detergent Compositions

*Pennsylvania Salt Mfg. Co., Dept. MF, 1000 Widener Bldg., Philadelphia 7, Pa.*

A new class of cleaning compositions, based on a chemical principle long known but not heretofore applied commercially in the detergent field, was announced recently by the above firm.

Called Solubilizing Cleaners, the new compositions were developed at the Whitemarsh Research Laboratories in the course of the company's research to find new ways to solve cleaning problems.

The action of the new cleaners is based on oversize micelles or groups of molecules, formed by the various ingredients, which have the property of dissolving not only water-soluble soils taken up by normal soap solutions but also water-insoluble soils which can normally be removed only by organic solvents. The Solubilizing Cleaners have little saponifying action and do not remove fatty soils by this mechanism, and while performing somewhat like emulsion cleaners, will go far beyond these in cleaning range because of their solubilizing action. In addition, they have the capacity of removing solid soils by detergent action and continue to clean effectively even when loaded with soil, it is claimed.

Because of these characteristics, Pennsalt researchers believe, the new cleaners will be particularly suitable for removal of difficult soils made up of combinations of water-soluble and water-insoluble materials, such as are frequently found in industrial processes.

The range of solvent power inherent in the new solubilizing cleaners is said to make them very effective in removing such complex soils as buffing compounds, greases and pigmented drawing compounds.

Pennsalt has four products already undergoing field tests and in semi-

commercial production, in the new class. These are SC-3, SC-21, SC-23 and SC-24. Others are in the process of development.

The SC products are clear liquids, yellow, dark brown or cherry red in color. Only limited clinical tests have been run to date; however, these materials have been specially formulated to reduce the probability of industrial dermatitis due to skin defatting. Vapor toxicity does not exceed that of usual emulsion cleaners, it is claimed.

The SC cleaners have a practically neutral pH, good solubility and dispersibility in water, moderately high flash point, and exhibit a high adsorption at interfaces.

The four available SC Cleaners, their properties and suggested applications are described in a Pennsalt new product bulletin, "Solubilizing Cleaners," which is available on request.

### Acid Resistant Cement

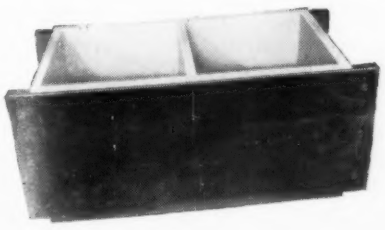
*The Atlas Mineral Products Co., Dept. MF, Mertztown, Pa.*

This firm announces Vitroplast, a newly developed, light-colored synthetic resin cement which is said to be resistant to many acids, solvents, greases and oxidizing agents such as sodium hypochlorite and chlorine dioxide. Unlike other resin cements, Vitroplast sets hard in contact with concrete and metals and exhibits excellent adhesion properties for the jointing of brick and tile and adhering glass, concrete, metal and other materials it is claimed. Bulletin 5-30E gives complete details on this new product.

### Polyethylene Tank Liners

*American Agile Corp., Plastics Div., Dept. MF, 5306 Hough Ave., Cleveland 3, O.*

Completely welded polyethylene plastic tank liners, both removable and stationary types, are now offered to industry by the above firm. These liners can be furnished in all sizes and shapes with wall thicknesses up to 1" and are fabricated entirely of polyethy-

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**ALMCO Supersheen**

**AMERICA'S LARGEST MANUFACTURER OF ADVANCED BARREL FINISHING EQUIPMENT—MATERIALS AND COMPOUNDS**

**ALBERT LEA, MINNESOTA**


lene to the customer's specifications by the Agile hot gas welding method.

Tank liners can be furnished with polyethylene drains and flows, including pipe flanges, fittings and valves also made of polyethylene. These component parts can be directly connected to other existing pipe lines and installations. The photograph shown here illustrates a bi-sectional removable tank liner which has been fitted into a wooden tank.

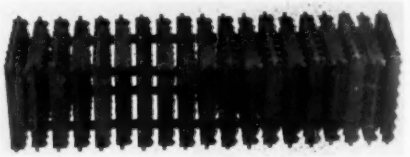
The chemical inertness of polyethylene and the hot gas welding method employed in the fabrication of such tanks is said to guarantee a leak-proof liner and reduce maintenance and replacement costs of storage and plating tanks containing corrosive liquids. Another important feature of liners of this type and construction is that they weigh but 1/13 of the weight of lead, and in proportion are much lighter than other metals used for tank lining.

Complete fabrication of these units may be done at American Agile Corp's. plant in Cleveland, or on the site of the final and permanent installation, depending upon the size and complexity of design.

### Carbon Heating Equipment

*Parlam Corp., Dept. MF, 336 Canal St., New York 13, N. Y.*

New types of equipment for the process industries, manufactured from an entirely new material of construction,



have been announced by the above firm. The equipment is of special interest to manufacturers having problems with corrosive materials.

The basis for the equipment is a unique carbon and graphite material, said to be superior in many ways to that heretofore available. It is remarkably strong and corrosion-resistant, with exceptional properties of refractoriness and *controllable* thermal conductivity.

Available equipment includes coolers, heat exchangers, evaporators, boilers, scrubbing towers, tower-packing, tank linings and tiles, fume ducts, etc. Pumps and ejectors are now being developed, and are expected to be available within 3-6 months.

Because of newly perfected manufacturing techniques, the new carbon

material can be used to an extent impossible with carbon produced in the old way, it is claimed. Patented engineering designs taking advantage of the unique characteristics of the material will prove of unusual interest to engineers and production men, according to the firm.

The fabricated equipment, as well as the basic material, is manufactured in Europe, and distributed in the U.S.A. by Parlam Corporation. The company promises good deliveries on most items—from 6 to 24 weeks in New York.

### Phosphating Treatment

*The Du Bois Company, Dept. MF, Cincinnati 3, O.*

The above firm announces a new cleaning and phosphatizing compound to prepare steel and other metals for painting.

Ion-Kote is a white, granular, easy to handle, dustless powder used in spray washers prior to painting. It deposits a hard, dust-free, phosphate coating on metal which prevents rusting and increases paint adherence, according to this firm. It is said to clean rapidly and remove most cutting and forming compounds as well as rust preventives, smut and other dirts. Ion-Kote will also retard rusting of treated parts over the week-end before painting, it is claimed.

Further details and specific recommendations may be obtained by writing.

### New Bright Nickel Process

*Gill Corp., Dept. MF, 5317 St. Clair Ave., Cleveland, O.*

The Smoothex brightener process consists of new organic addition agents, (1) Smoothex #400, a primary brightener in powder form; (2) Smoothex #50, a secondary brightener in liquid form; Smoothex #200, a wetting agent in paste form that helps to control pitting. By the use of Smoothex #400, #50, #200 in a standard Watts formula, brightness is obtained right from the start of the plating cycle, it is claimed, and lustre intensity gains until the maximum brilliance is reached.

The Smoothex process is claimed to be unexcelled in line-filling properties. Marks of poor workmanship, flaws in material, or lines left by the polishing wheel are refilled. It can be operated


BRIGHT FINISHING SYSTEM

SPARKLES

LIKE CHROME!

*Leading manufacturers approve zinc plate and* IRIDITE® *Bright to replace conventional chrome plating*

If your problem is finding the right finish to replace conventional chrome plating, follow the lead of prominent manufacturers of all types of products . . . switch to zinc plate and Iridite Bright.

Here's what you get when you use this chromate finishing system to replace conventional chrome plating.

**SPARKLING BRIGHT APPEARANCE**

The zinc plate and Iridite Bright system resembles chrome so closely that visual inspection can scarcely tell the difference! And, the brilliance *lasts*.

**BETTER CORROSION PROTECTION**

Yes, you actually get better protection with zinc plate and Iridite Bright than with chrome plating . . . up to twice the life under accelerated salt spray conditions! And, by applying a clear baking lacquer over the Iridite coating you can increase the abrasion resistance and lasting qualities of this bright finishing system, at the same time making possible a greater salt spray protection.

**LOWER FINISHING COSTS**

One metal, zinc, replaces three so you save material costs and plating time. Iridite Bright goes on in a non-electrolytic chemical dip.

**Write or call today for your copy of our new Technical Bulletin describing all phases of this bright finishing system in detail. Tell us your bright finishing requirements. If possible send sample parts for test processing.**

Iridite is approved under government specifications

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Manufacturers of Iridite Finishes
for Corrosion Resistance and Paint Systems on Non-Ferrous Metals; ARP Plating Chemicals.


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Real economy in plating production hinges upon the proper rack design. NaRaCo can give you that added efficiency in racks making the difference between profit and loss.

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Investigation will convince you that NaRaCo Racks are a wise economy for you. Consult today the NaRaCo branch nearest you.

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1613 Industrial Avenue FLINT, MICH.

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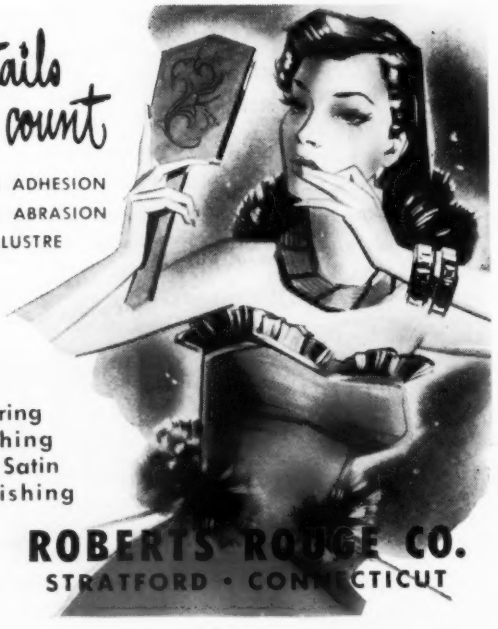

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Polishing
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STRATFORD • CONNECTICUT


at current densities from 5 to 100 amperes per square foot, and fine-grain structure of the electrodeposit is said to be assured, and lustre is good.

The process assures ease of control, superior brightness and color, and adaptability to the plating problems of the average job shop, it is claimed. Other processes are easily converted to Smoothex, conversion consisting of carbon filtrations, high pH treatment and addition of Smoothex materials to the treated bath.

The process is said to be competitive to plating processes of major companies.

### Odorless Emulsion Cleaner

*Fine Organics, Inc., Aviation-Industrial Chemicals Div., Dept. MF, 211 East 19th St., New York 3, N. Y.*

FO-106, Solvent Emulsion cleaner (a concentrate) was developed to meet the needs of industrial users who find Creslyic Acid odors and skin burns troublesome. It is claimed to meet fully the requirements of *Air Force Specification* 20015E and *U. S. Navy Specification* C-147, Type I.

FO-106 is intended to be diluted with kerosene or stoddard solvent in proportions from 4 to 9 parts solvent to one part compound. It is applied to metal, concrete or painted surfaces by brush or spray in diluted form, then rinsed off with cold or hot water. No oily film remains, it is claimed.

Since painted surfaces are not harmed, a 1-9 solution may be used, without rinsing, to wipe down production machines with complete safety to machines and men. It is highly satisfactory for parts cleaning and soaking to remove greasy deposits when used either in dip tanks or hydrowash machines, according to the firm. FO-106 may be diluted with water in all proportions for the latter use and heated to 160°F. for spray cleaning in process work.

FO-106 is available in 5 and 53 gallon drums.

### Chemical Bath to Remove Scale From Forgings

*Pennsylvania Salt Mfg. Co., Dept. MF, 1000 Widener Bldg., Philadelphia 7, Pa.*

One of the most difficult problems in production heat treating of steel forgings is the removal of furnace scale. Now the above firm is marketing a chemical bath which completely re-

moves this scale during quenching and has accounted for cost savings of 90% over previous methods used in industrial production, according to the firm.

The bath is made up of a new product, Pennsalt SR-4, dissolved in weak muriatic acid and water. The product was developed from a practice originated at the Toledo, Ohio, and Pottstown, Pa., plants of the *Spicer Manufacturing Division* of the *Dana Corp.* Pennsalt and Spicer researchers cooperated in the development and in laboratory and plant tests.

The Pennsalt SR-4 bath requires no heating and is made up in ordinary rubber-lined tanks. Dipping baskets can be made of simple sheet iron. Parts covered with forging scale are immersed in the bath for five minutes and then may be placed directly into heat treating furnaces or can be stored for later heat treating.

The forgings are heat treated at a temperature range from 1,500° to 1,600°F. and soaked at temperature for the minimum time consistent with good metallurgical practice. An additional saving results from the fact that the forgings can be heat treated in a non-reducing atmosphere or without a prepared atmosphere.

Following the heating the forgings are water quenched and tempered. In conventional operations, the tenacious furnace scale is then removed by expensive sand-or shot-blasting, but with the use of the SR-4 bath, this process is completely eliminated in most operations. When the forgings treated with SR-4 are water quenched, the scale actually blasts off from all surfaces, leaving them clean enough for subsequent machining.

Both laboratory tests and plant operations are said to have shown that the SR-4 bath provides for complete removal of scale from carbon steel forgings, even from deep indentations and blind holes difficult to reach in sand- or shot-blasting. The bath provides for efficient scale removal after heat treatment in most cases where oil quenches are used, and in such cases where scale removal is not complete, sand- or shot-blasting operations can be reduced considerably, it is claimed.

Satisfactory results have been obtained in SR-4 descaling of plain carbon steel grades and some SAE alloy steels. The product is currently undergoing field tests in several other industrial plants in order to determine its


Wheels CUT FASTER, LAST LONGER

When treated with Park KOLD-GRIP POLISHING WHEEL CEMENT

KOLD-GRIP Polishing Wheel Cement, laboratory-controlled through every step of production, will arrive at your plant *ready for use!* Viscosity is constant, regardless of normal temperature variations and the cement can be applied directly from the container . . . *without mixing or heating.* Kold-Grip is clean, odorless and very easy to handle.

Coarse or fine-grain abrasives set up right for fast cutting efficiency. Substantial savings are effected through longer over-all wheel life, fewer set-ups and reduced wheel inventory.

Wheels dry rapidly, are unaffected by humidity changes, and may be stored in any convenient plant area.

Let our polishing engineer demonstrate Kold-Grip for you, or send for free sample, telling us the metal to be polished, grain sizes to be used, and drying facilities available. We can help you if we hear from you.

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• Liquid and Solid Carburizers • Cyanide, Neutral, and High Speed Steel Salts • Coke • Lead Pot Carbon • Charcoal • No Carb • Carbon Preventer • Quenching and Tempering Oils • Drawing Salts • Metal Cleaners • Kold-Grip Polishing Wheel Cement

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**For uninterrupted production of highest quality plating look for the 999 "PLUS" FINE mark on the Silver Anodes you use.**

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effectiveness on remaining alloy compositions.

A New Product Bulletin describing Pennsalt SR-4, its properties and method of use is available upon request.

## NEW BOOKS

### Electroplating Baby Shoes Handbook

*Pub. by Lewis Electrical Mfg. Co., 1943 Walton Ave., New York 53, N. Y. 116 pages. Price $15.00.*

This is a complete handbook on the various methods that can be used for preparing and metallizing baby shoes. In addition, essentials of electroplating techniques are described so that the amateur, by following the detailed procedures, can turn out high quality work. Equipment and set-ups are illustrated with many drawings and photographs, and formulas for preparatory materials and plating baths are given, as well as sources for the various materials required. Copies must be ordered from the above firm.

### Electroplating

*By J. B. Mohler and H. J. Sedusky. Pub. by The Chemical Publishing Co., N. Y. C. Available from Finishing Publications. Price $5.00. 256 pages.*

This is essentially a practical book, although the authors have delved into electroplating theory here and there to explain certain points. The whole range of topics is covered, from bath make-up to maintenance, analysis and trouble shooting. In fact, the book seems to emphasize the trouble shooting aspect of practical plating room operation, if one subject had to be picked out as a high spot for this volume.

One subject that does not get the consideration it merits in a practical book is the subject of cleaning. Only several pages are devoted to the treatment of the subject, although it is true that many references are made to cleaning procedures throughout the rest of the discussions.

Alloy plating is unusually well covered, as would be expected in a volume by these two authors, who have had much experience in this field. Diffusion coatings are also described in some detail.

This book is not, nor was it intended to be, an all-inclusive treatment of the subject. It will, however, be useful to the practical operator or plant chemist who must keep things running smoothly in the plating room.

W. A. R.

## Business Items

### Cooper Joins F. B. Stevens in Sales Capacity

J. J. Cooper

*Frederic B. Stevens, Inc.*, of Detroit, have announced the appointment of *Mr. James J. Cooper* to their sales organization.

Mr. Cooper will serve as sales consultant representing the Stevens line of buffing compositions, plating equip-

ment, and plater's supplies in the Chicago area.

He has had considerable experience in the metal finishing field. For the past five years he has been a sales representative for a distributor of chemicals and minerals for the metal finishing industry. Mr. Cooper's prior experience was obtained in the metal working and chemical processing trade.

### Young Appointed District Mgr. for Wagner Bros.

William Young

*Wagner Brothers, Inc.*, Detroit manufacturers, have announced the appointment of *William Young* as District Sales Manager for their Cincinnati and Southern Ohio territory.

Mr. Young is a well-known figure in the metal finishing industry, having been associated since 1944 with the Udylite Corp., first as an equipment engineer and later as sales representative. During the fifteen years prior to that he held similar positions with Chrysler Corp., Great Lakes Steel Co., and National Tube Co.

Mr. Young will serve polishing and plating industries in the area, handling the entire Wagner line. The company manufactures and supplies buffing and polishing equipment, plating chemicals, tanks and complete automatic systems.

### Free Evening Classes in Electroplating

The new term for the course in *Electroplating* at the Brooklyn Evening Technical High School, 29 Fort Greene Place, Brooklyn 1, New York, will commence September 12, 1951. The course includes a review of elementary chemistry, a study of electroplating solutions and the various methods of analysis of acid copper, chromium, nickel and cyanide baths; class work is supplemented by laboratory work where these analyses are performed by the students. Testing of electrodeposits for thickness measurements are made by microscopic and chemical methods. Hardness tests are determined by the Rockwell, Brinnell, Vicker's and Scleroscope methods. Further study will include the preparation and operation of common electroplating baths under varying conditions.

The course is free, and is open to men in the electroplating industry. Registration begins September 10, 11, 1951 from 7:00 to 8:30 P.M. Classes are held from 6:30 to 8:20 P.M.

Inquire in the General Office, Room 1 W 2 or Room B W 17.

**. . . Money-Saving Oven Installation at Estate Heatrola Division Noma Electric Corporation Hamilton, Ohio**

This conveyorized, moisture removal oven dries two ground coats of frit on stove parts. The oven is direct gas-fired and automatically controlled.

From the unload end, the material passes immediately to spray booths where the second ground coat is applied. The material has retained enough heat from the drying of the first coat to immediately dry the second coat after spraying.

To conserve floor space, heating equipment is mounted on top of the unit, together with recirculating and exhaust fans.

Whatever your need in ovens, for drying, dehydrating or baking, consult KIRK & BLUM. Ask for booklet on "Industrial Ovens".

KIRK AND BLUM

INDUSTRIAL OVENS

The Kirk & Blum Mfg. Co.
3159 Forrer Street
Cincinnati 9, Ohio


### Klem Chemicals Appoints West Coast Representative

*Klem Chemicals, Inc.*, Dearborn, Mich., announces the appointment of the *Currier Company* as west coast representatives for their line of metal cleaning and conditioning chemicals.

The Currier Co. maintains offices in Seattle, Washington; Denver, Colorado, and warehouses in Oakland and Los Angeles. They are designers and builders of degreasing and metal washing equipment, also spray booths and conveying systems.

They maintain a large staff of well trained engineers, and will be in a position to provide excellent service for Klem products in the west coast area.

The addition of the Currier Com-

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# If you make a bath like this

## ...it's time you switched to NEW SILVER SOL-U-SALT

***Note these advantages!***

- **High Purity eliminates harmful ingredients introduced to plating solution.**
- **No filtering necessary.**
- **Eliminates waste.**
- **No rough deposits.**
- **Dustless, eliminating hazard of other type air-borne powders.**
- **Does not affect the free cyanide content of the plating solution.**
- **Precalculated — 2 ounces avoirdupois of Silver SOL-U-SALT contains 1 troy ounce of metallic silver.**

***Available in 100, 200, 500, 1000 and 2000 ounce plastic packages.***

**SILVER SOL-U-SALT is a water soluble double cyanide salt. It is a pure white crystalline, free-flowing salt of known and definite chemical composition. Developed for making new Potassium Silver Cyanide plating solutions or for metal replenishment in existing baths.**

***No more dirt, dust, mixing, calculating or filtering!***

*An exclusive development of*

Sel-Rex

**SEL-REX PRECIOUS METALS, INC.**

**M7 229 Main Street • Belleville 9, N. J.**


pany to the distributing facilities of Klem Chemicals will permit west coast manufacturers to have the advantages of the technical service and progressiveness for which Klem Chemicals is noted in the mid-west and eastern territories.

### Sarco Moves Chicago Headquarters

The Chicago midwest headquarters for *Sarco* sales representatives moved on April 30 to new and larger space at *322 West Randolph St., Chicago 6, Ill.* The new telephone number is *Andover* 3-2513-4-5.

This manufacturer of steam specialties has its main sales office in the Empire State Building, N. Y. C.; the factory is at Bethlehem, Pa.

*George H. B. Burke*, manager of the Sarco midwest headquarters, has been with the company for 40 years. Other veteran sales engineers include:

R. L. Stewart.
C. E. Brakenridge
E. J. Avery.
O. W. Clark.
D. E. Shrader.
C. F. Bremigan.

### Don Gaines New England Manager for Formax

*Formax Mfg. Corp.*, Detroit, Mich., manufacturers of polishing and buffing wheels, buffing compounds and polishing wheel cements, has appointed *Don A. Gaines* New England Regional Manager, according to an announcement by *Edward McAleer*, Vice-President.

D. A. Gaines

Mr. Gaines was one of the Formax sales representatives in the Detroit area and has moved his residence to 333 Buena Vista Road, Stratfield, Conn. During his nineteen years of sales experience in the metal finishing field, he has acquired an enviable record as a practical technician in the application and use of the firm's products. He is particularly well versed in the installation and maintenance of spray equipment for use with liquid buffing compounds.

### Kirk Mattson Joins Pennsalt

*Kirk C. Mattson* has joined *Pennsylvania Salt Mfg. Co.* of Washington as District Sales Manager of the company's Los Angeles office.

Mr. Mattson will supervise sales and service of the Industrial Chemicals and Agricultural Chemicals Departments in Southern California, Arizona, Nevada and New Mexico. Pennsalts' Southern California office is located in the Westland Warehouse Building, 4820 Loma Vista Avenue, Los Angeles.

Mr. Mattson assumes his new position after 15 years' experience in the marketing of industrial and agricultural chemicals in California. Until recently he operated his own chemical sales agency, the Mattson Chemical Company, in Los Angeles.

A native of Berkeley, California, he now lives in San Marino. He is a member of the Jonathan Club of Los Angeles and the Southern California Section of the American Chemical Society.

### Lucas to Assist Detrex Western Manager

*William F. Lucas* has been appointed as assistant to *E. H. Ehlert*, West-

ern Region Manager of *Detrex Corp.*, Detroit, Mich.

Mr. Lucas, who will make his headquarters in the Chicago office, 600 South Michigan Ave., will supervise the technical applications and the field servicing of Perm-Cote, phosphate-type of rust-proofing compounds, and Detrex alkaline and emulsion cleaners, in Wisconsin and northern Illinois.

### Dr. J. F. Gall, of Pennsalt Heads Phila. Section of Electrochemical Society

*Dr. John F. Gall*, Supervisor of Research in the Research and Development Division of the *Pennsylvania Salt Mfg. Co.*, has been elected chairman of the Philadelphia Section of the Electrochemical Society.

Dr. Gall has also served as chairman of the national society's Theoretical Div. and Electric Insulation Div. He is a former councilor and is now a director of the Philadelphia Section of the American Chemical Society and is a member of the American Association for the Advancement of Science.

Dr. Gall joined Pennsalt in December, 1938, after completing his work for the degree of Doctor of Philosophy at the University of Chicago. At Pennsalt's Whitemarsh Research Laboratories he headed much of the company's research in fluorine chemistry.

### Steffins Appointed Sales Engineer for Osborn

*A. J. Steffens, Jr.* has been appointed Sales Engineer for the *Osborn Mfg. Co.*, Cleveland, O.

Mr. Steffens, who will cover the North Carolina, South Carolina, Eastern Georgia, and Florida Territories, was formerly associated with the National Litho Forms Co., Cleveland, as a Systems Engineer. He also served with Remington Rand as a Systems Division Salesman.

A. J. Steffens, Jr.

Mr. Steffens attended Fenn College, and was graduated from Western Reserve University with a degree in Business Administration. He did graduate work at Western Reserve in Industrial Engineering.

Mr. Steffens is a member of the Cleveland West Side Industrial Club and Lambda Iota Delta, Engineering fraternity.

He will make his home in Westover Hills, Charlotte, N. C.

### Dunne and Clemmer to Represent Cro-Plate Company, Inc.

*The Cro-Plate Co., Inc.* of Hartford, Conn., industrial hard chrome platers and manufacturers of metal finishing and plating equipment, has announced the appointment of *Richard J. Dunne* as Eastern Division Sales Engineer.

In his new position, Mr. Dunne will serve the chrome plating needs of metal working plants and printing houses in the New York and New Jersey area.

Mr. Dunne comes to the Cro-Plate Co., Inc. from the Cylinder Plating Corp., of New York, where he was concerned with the sale of copper plating to rotogravure printers.

Mr. Dunne attended New York

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***Direct Motor Drive***

**TILTING TUMBLING BARRELS**

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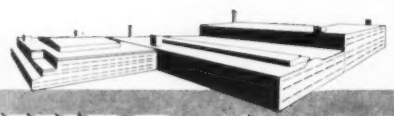
Process thousands of pieces at one time—faster, better and at lower cost—with Globe Precision Tumbling Barrels, dependable for 47 years. Globe's exclusive six-way work shifting motion cuts tumbling time and increases action. Speeds as low as 30 revolutions per minute assure finer finishes of non-ferrous metal parts. Motor is compactly mounted above the gear segment for space economy.

***Free Experimental Service***

Hupp's Experimental Engineering Laboratory can show you how to cut finishing costs. Just send samples of the parts to be processed along with a finished part. Write today! There's no charge or obligation.

**Hupp Manufactures a Complete Line of Tumbling Barrels and De-Burring Machines.**



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**GLOBE STAMPING DIVISION**

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**SERVING INDUSTRY SINCE 1902**

R. J. Dunne

C. W. Clemmer, Jr.

Univ., is a native of Paterson, N. J. and currently resides in New York City.

The firm has also announced the appointment of *Clarke W. Clemmer, Jr.* as Eastern Div. Equipment Engineer. In his new position Mr. Clemmer will be concerned with engineering and sales of the company's wet-blasting and chrome-plating units in the Connecticut and Massachusetts area.

Most recently a special agent for the Northwestern Mutual Life Insurance Co., Mr. Clemmer formerly was engaged in refrigeration research for Westinghouse as an engineering laboratory technician.

A graduate of Yale and a Navy veteran, Mr. Clemmer is a resident of East Longmeadow, Mass.

### Ward Leonard Appoints Distributors

The Industrial Chrome Division, *Ward Leonard Electric Co.*, Mount Vernon, N. Y. announces the appointment of the following companies as distributors of Chromaster and Chromasol:

| NAME | TERRITORY |
|---|---|
| S. B. Roby Co.<br>208-214 South Ave.<br>Rochester 4, N. Y. | Rochester area |
| Syracuse Supply Co.<br>314 West Fayette St.<br>Syracuse 1, N. Y. | Syracuse area |
| Logan Hardware & Supply Co.<br>Huntington, W. Va. | West Virginia |

Chromaster is the registered trade name for Ward Leonard's new line of industrial hard chrome plating units. Chromasol is the registered trade name for the non-critical hard chrome plating solution used in Chromaster units.

### Simonds Abrasive Open Warehouses in Chicago and Detroit

*Simonds Abrasive Co.*, grinding wheel and abrasive manufacturers, Philadelphia, Pa., announce new branch office and warehouse facilities in both Chicago and Detroit.

The new Chicago warehouse, located at 3323 W. Addison St. is occupied jointly with the parent company, *Simonds Saw & Steel Co.*, Fitchburg, Mass. It provides larger, more modern quarters and offers a complete service for all Simonds' products in the Chicago area.

In Detroit, the new warehouse is located at 17155 Conant Avenue, and offers an enlarged and expanded grinding wheel and abrasive service for the specialized needs of industrial Michigan.

### Price of Nickel Increased

To compensate for substantially higher labor costs resulting from new union agreements effective June 1, and for other production cost increases, *The International Nickel Company, of Canada*, Limited, recently announced an increase of 6c (U. S.) per pound in the domestic and export price of nickel, effective June 1.

The Company has just entered into new one-year union agreements which reduce the work week from 44 hours to 40 hours for its 14,000 hourly employees in Canada and increases substantially their take-home pay.

The price increase is necessitated by an addition of $15,000,000 a year in the Company's production costs, resulting from the new union agreements and other higher plant costs for materials, supplies and other items.

### Weber New Sales Engineer for Allied Metal Specialties

*Allied Metal Specialties, Inc.*, 516 N. Charles St., Baltimore has announced the appointment of *Charles H. Weber, Jr.*, as Sales Engineer for the New England states.

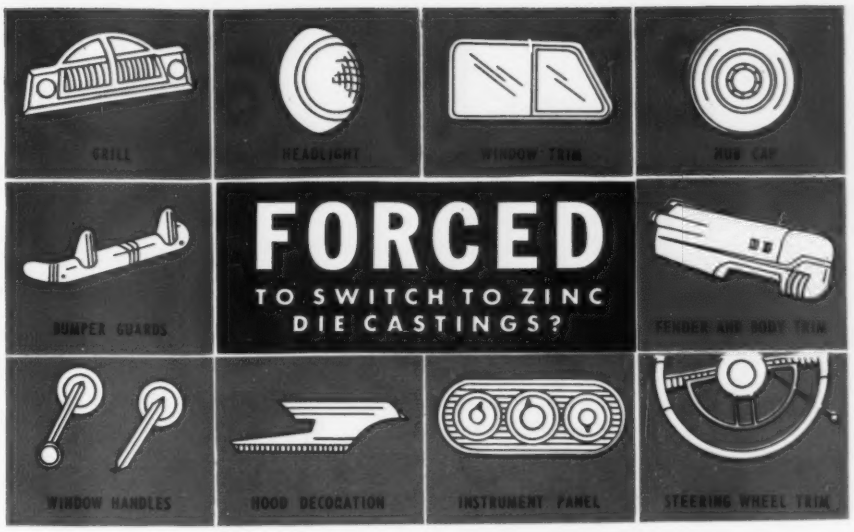
Mr. Weber, who received his B.S. degree in Engineering at Newark College of Engineering, will handle all matters relating to the design, sale and servicing of Allied's line of Metal Crates, Baskets, Trays, Fixtures, Muffles and Retorts.

### Murray-Way Corporation Occupies New Plant

*The Murray-Way* personnel and clients formally celebrated the occupancy of the Corporation's new plant and offices, located on Maple road, east of Birmingham, with an open house, Saturday, May 19th. The opening of this new modern structure marks the third expansion step since the Murray-Way firm was founded by its President, *Ernest E. Murray*, in 1940.

The new building affords approximately three times the floor area of the former Detroit location and plans have been made for still further expansion, as needed, on the company's five acre property.

In the new quarters, Murray-Way


**Protect them with M & W Clear Coatings that stand 800 HOURS OF SALT SPRAY!**

● Zinc die castings and zinc plated steel are being used more and more as big manufacturers swing to these parts to replace unavailable materials. BUT the copper, nickel and chromium normally used for plating are in tight supply *too.*

Here's an effective way to meet this new problem. *Coat the die castings and zinc plated steel parts—instead of plating them!* Coat them with the M & W finishes that stand up under salt spray and weatherometer tests for the extraordinary period of 800 hours . . . that protect the zinc against discoloration!

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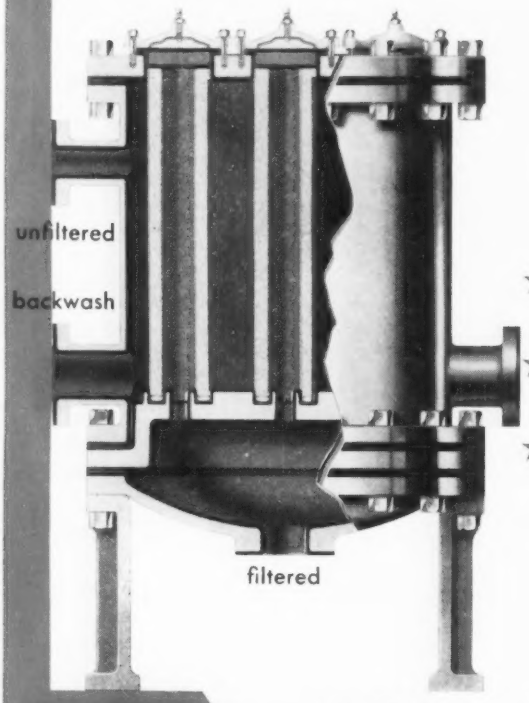


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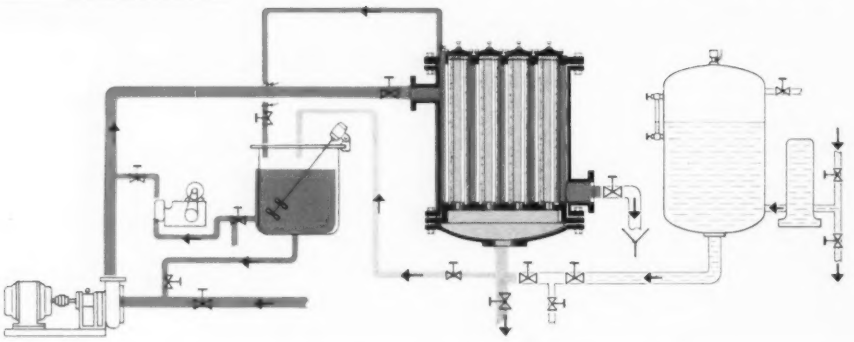



will increase the production of its well known automatic Micro-Polish units (the process for polishing flat metal sheets, rolls or blanks before forming). The company will also expand the manufacture of its line of standard design polishing and buffing heads and automatic conveyors engineered to Mr. Murray's original idea of the need for a more universal and flexible line of automatic polishing equipment.

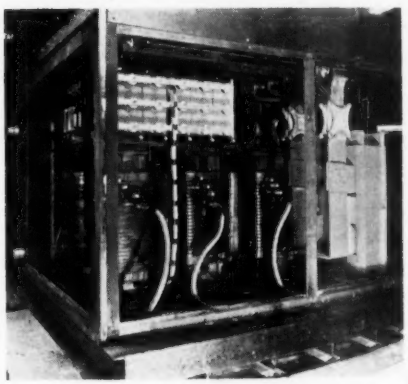
Besides the manufacture of its special-built and standard equipment, Murray-Way has opened a new department to handle contract polishing of sheet, blanked or coiled stock for manufacturing companies.

In its eleven years of existance, the company has grown from a purely local institution, supplying a few automotive plants, to a national and international operation supplying industry of every type, and the name Micro-Polish has become a by-word in the trade.

The corporation officers are:

| | |
|---|---|
| *Ernest E. Murray* | President |
| *Donald M. Teer* | Vice President |
| *Roman J. Zech* | Secretary |
| *Robert J. Gilmore* | Treasurer |

**Huge Rectifier Built for Automotive Manufacturer**



Engineers at the *Bart-Messing Corp.*, Belleville, N. J., recently developed what is believed to be the largest single-unit selenium rectifier ever built. This Sel-Rex unit has a capacity of 14 volts at 13,000 amperes, almost double the capacity of any previously known rectifier. It is installed in the plating plant of one of the country's leading automobile manufacturers to furnish the required DC power.

Hermetically sealed against corrosion, the rectifier is automatically controlled by means of saturable reactors and electronic circuits to maintain constant voltage.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## Foster New Assistant to V.P. of Apothecaries Hall

The management *Apothecaries Hall Co.*, manufacturers and distributors of plating supplies and equipment, announces the promotion of *Frederick S. Foster* to the position of assistant to the vice-president.

Mr. Foster is a graduate of DePauw

Frederick S. Foster

Univ., Greencastle, Ind., class of 1932, where he majored in chemistry. He received a B.A. degree and was elected to Phi Beta Kappa. He took one year post graduate work at Colgate University.

Mr. Foster has been associated with Apothecaries Hall Co. since 1934. He worked in the company's analytical and research laboratory for seven years. He was in charge of allocations and priorities for three years. For seven years Mr. Foster has been in the sales department, and since 1948 has served in the capacity of sales engineer.

In his new position Mr. Foster will be in charge of purchasing and sales promotion of the company's heavy chemical and plating supply departments. He will also have certain general administrative responsibilities.

### CORRECTION

In the article "*Electroplating Stainless Steels*" in the June issue, by *Joseph Haas*, the author has called our attention to an error. Page 50, last paragraph should read "soft iron (.09% carbon)" instead of "soft iron (.9% carbon)".


ROTO FINISH

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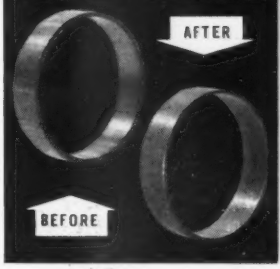


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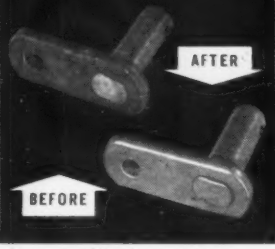


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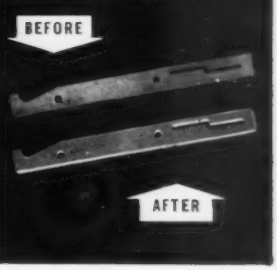
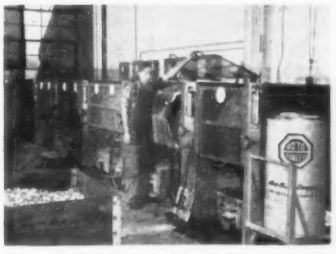



helps 6 people do the work of 16

The Whirlpool Corporation found a real solution to manpower scarcities and rising prices when they installed Roto-Finish Deburring Machines. By this mechanical method, 6 people now deburr an even greater quantity of parts than 16 could do before. Thus a much needed source of manpower was found for use in other operations.



The cost of deburring individual parts has been reduced 50% to 90% as shown above. And in addition, parts can now be deburred economically that were impossible to do by hand methods because the cost was prohibitive. Roto-Finishing these parts in some cases has eliminated special handling in subsequent operations. As a result, production has been speeded and manhours have been saved in stamping, grinding and other finishing operations.

Let us show you how you can make similar savings in time, manhours and money. Send sample parts to the Roto-Finish laboratory for a free demonstration. Write for full details today.

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* Pieced Buffs are made of all types of materials and all types of sewings are available. Extremely economical in many cases especially where pieced buffs are as effective as any other type of buff.
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## Manufacturers' Literature

### Chromic Acid in Metal Finishing

*Diamond Alkali Co., Dept. MF, Union Commerce Bldg., Cleveland 14, O.*

This firm has just published a 28-page booklet on Chromic acid and its uses in the metal finishing industry. Included is information on chrome plating, anodizing, cleaning, stripping, chemical control methods, commercial grades of chromic acid, and various helpful tables regarding additions to chrome plating baths and chrome plating speeds. Copies are available on request to the above address.

### Iridite Treatments

*Allied Research Products, Inc., Dept. MF, 4004 East Monument St., Baltimore 5, Md.*

This firm has just issued a new four-page, two-color bulletin describing in detail the entire line of Iridite finishes for non-ferrous metals. A section of the bulletin also covers the ARP process chemicals which include brighteners for zinc and cadmium plating and other specialties.

The technical data in the folder is presented in chart form and describes the four major functions of Iridite: corrosion resistance, paint adherence, eye appeal and technical advantages, in terms of their relation to three categories of metallic surfaces: zinc and cadmium, aluminum and cuprous alloys.

Copies may be obtained by writing the manufacturer direct.

### Hydrogen Peroxide

*Pennsylvania Salt Mfg. Co., Dept. MF, 1000 Widener Bldg., Philadelphia 7, Pa.*

This firm has just issued a new bulletin on Hydrogen Peroxide especially prepared for workers who need a compact, ready reference of a general nature.

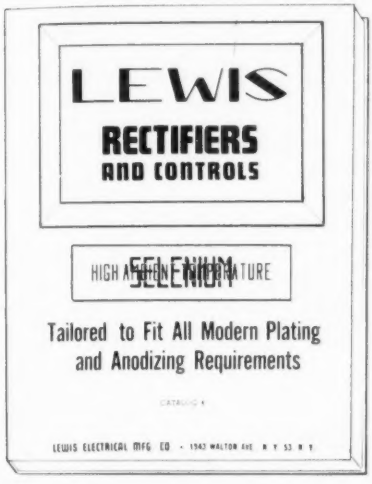
The book is written in non-technical language to meet the requirements of plant foremen and workers and for those who are considering using hydrogen peroxide for the first time. Industrial executives and purchasing agents who do not require complete technical information will also find the bulletin useful as a concise reference.

A number of suggestions for the application of this product are presented to acquaint the reader with possible ways in which hydrogen peroxide may be used to greater advantage. Recommendations are also made on the use, handling, shipping and storing of hydrogen peroxide. For those who are unfamiliar with the terminology used in connection with hydrogen peroxide, a brief explanation is given.

The bulletin is available on request.

### Selenium Rectifiers

*Lewis Electrical Mfg. Co., Dept. MF, 1943 Walton Ave., N. Y. 53, N. Y.*




This firm announces the availability of a new catalogue describing their line of selenium rectifiers for all types of electrolytic treatments in the metal finishing field. The units are available as self-contained, basic, or remote controlled units in capacities up to 10,000 amperes.

The catalogue also gives useful information on rectifier wiring diagrams and current carrying capacities of various sizes of conductors. Free copies are available on request to the above address.

### Vapor Degreasing Handbook

*Phillips Mfg. Co., Dept. MF, 3475 W. Touhy Ave., Chicago 45, Ill.*

A new 21-page handbook on vapor degreasing of metal parts has been published by the above firm. The handbook answers most questions generally asked about vapor degreasing, completely covering the subject of what vapor degreasing is and to what types of materials and manufacturing vapor degreasing can be applied. Numerous photographs of various types of units along with useful data charts are also included in the booklet.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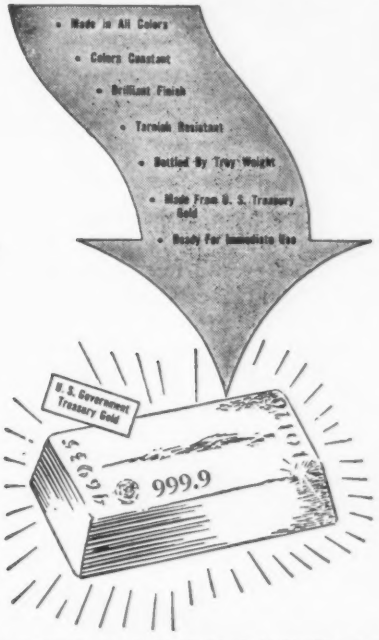
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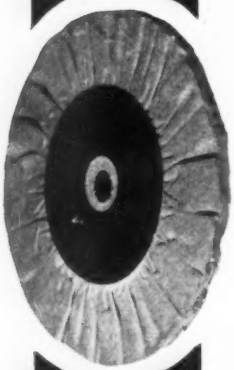

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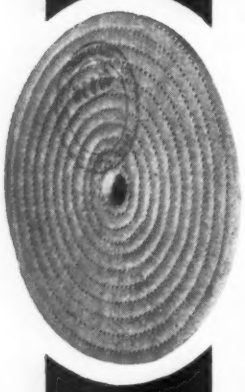

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### Water Treatment

*Brooks Chemicals, Inc., Dept. MF, 3304 E. 87th St., Cleveland 27, O.*

This firm has published a 16-page booklet on "Water Treatment and Water Conditioning." The booklet gives considerable technical data and describes Brooks services, products and methods employed in solving the many water problems encountered in industries, institutions and governmental works.

Brooks water treatment service is divided into the following seven categories: 1) Boiler Water Treatments, 2) Water Line Treatments, 3) Cooling Water System Treatments, 4) Brine System Treatments, 5) Waste Water Treatments, 6) Zeolite Softener Treatments, 7) Consulting Service.

Included in the booklet is a study of ten impurities common in water, the damage they cause and how to combat them.

### Chemicals for Metal Finishing

*Wyandotte Chemicals Corp., Dept. MF, Wyandotte, Mich.*

A new booklet, "Graphic Presentation of Wyandotte Products for the Metal Working and Metal Finishing Industries," is now available—ask for Form 1402.

The booklet contains recommendations for barrel finishing, for maintenance of water-wash spray booths, and for many cleaning operations.

### Cleaning for Black Oxide Finishing

*Oakite Products, Inc., Dept. MF, 125A Thames St., New York 6, N. Y.*

Helpful data on materials and procedures that produce the chemically clean surfaces required for black oxide finishing of metals is presented in a special Service Report available from the above firm.

After first stressing the importance of proper preparation of metal surfaces to assure consistent, uniform, non-mottled coatings, the Service Report reviews in detail recommended materials and methods for performing the following preparatory operations before black finishing: (1) alkaline cleaning of ferrous metals to remove light soils; (2) solvent cleaning where heavier soils must be removed; (3) electrocleaning ferrous metals to remove carbon smuts and other coatings; (4) rust and scale removal; (5) controlling acid solutions when pickling iron and steel; (6) tank-cleaning of non-ferrous metals; and (7) electrocleaning non-ferrous metals. Formulas for using the materials recommended for these operations are specified in each instance.

A special section of the report describes how a hot-oil bath treatment for black-oxide coated parts not scheduled for organic finishing enhances the black finish and provides effective anti-rust protection. In conclusion, the report reviews materials and methods for stripping black finishes from iron and steel and non-ferrous rejects.

### Selenium Rectifiers

*Rapid Electric Co., Dept. MF, 2881 Middletown Rd., Bronx 61, N. Y.*

This firm has just issued a bulletin describing their TC1512 model, which has an output of 1,500 amperes at 0-12 volts. The unit features single knob control, non-interrupted current while changing, and many other important and practical advantages. In addition the bulletin shows the many construction features of Rapid rectifiers and explains their advantages. Copies of the bulletin are available by writing to the above address.

### Tumbling Barrels

*D. J. Murray Co., Dept. MF, Wasau, Wis.*

A new bulletin entitled "Murco

Tumbling Barrels" describes six new models, both constant and variable-speeds, with complete specifications of each model. Copies may be obtained by writing to the above address.

### Wet Blasting Units

*The Cro-Plate Co., Inc., Dept. MF, 747 Windsor St., Hartford 5, Conn.*

A 4-page illustrated folder describing a line of newly developed compact wet-blasting units with no moving parts, designed for high production rate deburring, descaling, stock removal and general surface finishing, is available from the manufacturer.

### Cut-Wire Blasting Shot

*Cleveland Metal Abrasive Co., Dept. MF, 835 E. 67th St., Cleveland 3 O.*

This firm has recently published a 4-page folder on its cut-wire shot for cleaning and peening.

Well-illustrated with before and after-use photos, the folder describes economies and characteristics of Cleveland's cut-wire shot. A comparison table is included showing money saved by a large manufacturer through the use of this shot.

A copy of this folder may be obtained by writing to the above address.

### Serrated Surface Contact Wheel for Belt Polishing

*The Carborundum Co., Dept. MF, Niagara Falls, N. Y.*

A recent bulletin by this firm illustrates and describes the advantages of their new "61" contact wheel for abrasive belt polishing. The advantages claimed for the wheel are longer belt life, more pieces finished per belt, less operator fatigue, better finish, less down time for belt changes. The new wheel features a specially designed serrated face that resembles the face of a milling cutter, which is said to result in amazing step-up of belt efficiency and cutting action. Copies of this descriptive bulletin are available by writing to the above address.

### Solving Heat Transfer Problems

*Kold-Hold Mfg. Co., Dept. MF, Lansing, Mich.*

New laboratory data on the use of Platecoils as a medium of heat exchange is now available in a new technical manual published by the Platecoil Division of the above firm. This technical data is based, in part, on the results of an extensive research program conducted by the Battelle Memorial Institute involving all styles and representative sizes of Platecoils. The technical manual thus provides the engineer with the principal data required in the solution of heat transfer problems. It simplifies the process of selecting and applying industrial heat transfer equipment by supplying charts and formulas to aid in the basic calculations of industrial heating and cooling applications. These technical manuals are available by writing.


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### Wooden Tanks

*National Wood Tank Institute, Dept. MF, Chicago, Ill.*

A new booklet "This Great Age" is devoted to the properties and advantages to be gained from the use of wooden processing tanks in industry. How the tanks are made, how and why they are used in competition with other materials, information on their care and maintenance, and many other topics are all nicely described and illustrated. Copies may be obtained from the above institute.

### Automatic Tank Heaters

*The Still-Man Co., Dept. MF, 429 E. 164 St., N. Y. 56, N. Y.*

Data sheets on electric immersion heaters for heating small and medium sized tanks have recently been published by the above firm. Various types up to 25" in length are available. Copies of these data sheets may be obtained by writing to the above address.

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## News from California

By Fred A. Herr

*Menasco Mfg. Co.*, Burbank, Cal., has completed a 40 x 40 foot addition to its plating shop, doubling its former dimensions.

The expansion was necessary to house additional machinery which has been acquired to handle the polishing and plating on increased volumes of government contracts, largely for airplane landing gear. Recently put into service in the plating room were chrome facilities of 3,000 gallons capacity, two 1,000 gallon and one 500 gallon zinc tank. Hold-over equipment includes two cadmium tanks.

*S. Hark* is foreman of the Menasco plating department. *J. O. Powell* serves the firm as metal finishing engineer.

---

An outlay of well over $100,000 is reported to be represented by the new machinery and equipment recently installed at the Los Angeles plant of the *U. S. Spring and Bumper Company*. Shop practice in the manufacture and finishing of cold-roll steel automobile bumpers has been changed from polishing the cold-rolled bumpers *after* forming to pre-polishing the hot-rolled steel *before* the forming operation. A new flat polishing line has been installed and new draw-coat operation facilities have been added. *Alex Regmunt* is plating superintendent.

---

*Art Craft Plating Co.*, Burbank, Calif., has completed a new building measuring 125 x 140 feet to house its plating operations. New equipment, supplied through "Carload Andy" offspring of the *Sundmark Supply Co.*, Los Angeles, consists of two 14'x4'x4' anodizing tanks equipped with a 2,000 amp. generator, two additional hard chrome tanks and a 2,000 gallon zinc tank. The shop's work is almost exclusively on airplane parts. *Meyer Roter* and *James Barker* are the owners.

---

Two years after establishing the *Sunset Plating Co.* at 432 North Varney Street, Burbank, Calif., as a two-man shop, *H. F. Pierce* and *A. W. Habitz* reported that on June 1, 1951 their plant personnel totals 20. The shop is equipped to do cadmium, hard chrome and anodizing, which operations are devoted mainly to airplane parts at present.

---

*Marshall Blane*, formerly with Monsanto Chemical Company, St. Louis, Mo., has been named process engineer in the main Los Angeles laboratory of *Turco Products, Inc.*

---

A visitor to Los Angeles in mid-June was *Dr. C. L. Faust*, supervisor of the electrochemical engineering division of Battelle Memorial Institute, Columbus, Ohio. He conferred in Los Angeles with *Jack Raskin* and other executives of the L. H. Butcher Company relative to that firm handling the distribution of an electrochemical polishing process. On the night of June 13 he drew a full house at the meeting of the American Electroplaters Society in Los Angeles to hear him discuss electrochemical polishing.

---

*Cherry Rivet Co.* has announced acquisition of a 10-acre tract near El


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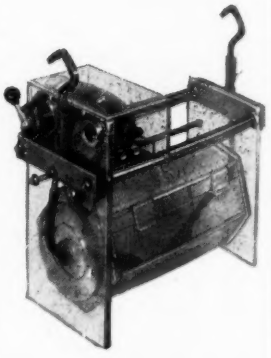

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Monte, Calif., as the site for a new 84,000 square foot plant designed for the production and finishing of solid steel and tubular rivets and other items. Completion of the plant is expected by mid-September.

*Ryan Metals Products Co.*, Los Angeles, has opened a plant at 241 West Avenue 26 for the development and manufacture of metal specialties, including racks, stands and hand trucks.

*The Magnaflux Corp.* has opened enlarged Southern California offices and warehouse in 5148 Alcoa Ave., Los Angeles. The new facilities are reported to make for increased service and repair facilities. The new location includes a laboratory equipped with conveyorized Magnaflux and Zyglo equipment to put inspection on a production line basis.

*R. G. Strother* has been named branch manager of the Magnaflux Corp. He has been with the firm as a field engineer in the Southern California area since 1945, having previously served with Lockheed Aircraft Co. and the Packard Motor Co.

## Associations and Societies

### AMERICAN ELECTROPLATERS' SOCIETY

**Detroit Branch**

### British E.T.S. Honors Dr. Wm. Blum

An interesting ceremony took place at a special meeting convened by the Detroit Branch of the A.E.S. on Friday, May 18th at the Hotel Statler. A record attendance of members from all parts of the country, including the Supreme President of the A.E.S., *Mr. Wm. Neill*, watched *Dr. S. Wernick*, Honorary Secretary of the British Electrodepositors' Technical Society confer Honorary Membership in the British Society on *Dr. Wm. Blum*, of the Bureau of Standards, Washington.

Speaking on behalf of the President and Council of the E.T.S., Dr. Wernick said that Honorary Membership in the E.T.S. was conferred on a small and select number of men of distinction in the field of electrodeposition and metal finishing. It was hardly necessary to enumerate the reasons why Dr. Wm. Blum was being so honored. In Gr. Britain they looked upon Dr. Blum as the "Grand Old Man" of plating, and one of the most outstanding men in the research field. His technical and scientific achievements were many and his contribution to the advance of science noteworthy. Dr. Blum came to England just before World War II and made a profound impression on Brit-

Dr. Blum receiving Honorary E.T.S. Membership certificate from Dr. S. Wernick, E.T.S. Secretary.


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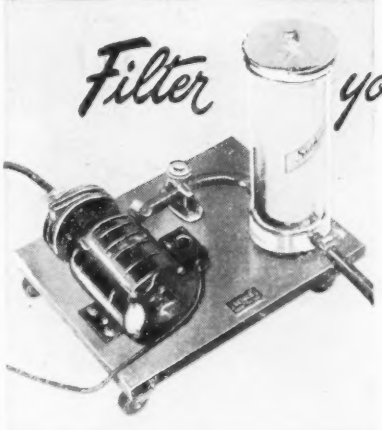

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ish technologists. He therefore felt it a great honor to present, in behalf of the President and Council of the E.T.S., the Certificate of Honorary Membership.

Dr. Blum's acceptance included the following remarks:

"I am happy and proud personally to receive this honor from the Electrodepositors' Technical Society. If I were the only one concerned in this award, it would have far less significance than it deserves. It pleases me greatly to mention those who may well share this honor with me."

"First, my associates at the National Bureau of Standards (over 100 in the course of the years) who have conducted the researches on which this award was largely based. Second, the American Electroplaters' Society, whose interest and support have stimulated research in this field. And finally, the Detroit Branch of the AES, in a city that may well be called the "plating center of the world" (as well as the automobile center)."

"It is a special honor to receive this recognition from England, to whom we owe the origins of electrodeposition in the classical researches of Humphrey Davy and Michael Faraday. It is an added honor to receive this award from the Electrodepositors' Technical Society, which in the twenty-five years of its existence has published so many noteworthy researches in the field of electrodeposition."

"In these troubled times it is especially important that the people of England and America know and understand each other, so that they may work together for the preservation of democracy throughout the world. In the fields of science and technology we are fortunate to have increasing opportunities for close association of England and America. Especially in our field of electrodeposition it is fortunate that during recent years there have been many visits between our two countries. We are happy to have Dr. Wernick with us again. Through just such visits we may well hope that mutual understanding in the larger affairs of state may result."

Dr. Blum, in his long and illustrious career, has also been the recipient of the following honors:

1926—Medal of Institute of Chemists.
1944—Acheson Medal of The Electrochemical Society.
1951—Gold Medal of The Dept. of Commerce.
1951—ASTM Award of Merit.

Later, Dr. Wernick publicly handed to *Mr. Walter Pinner* his Certificate of Honorary Membership, which was awarded to him in 1948.

Subsequently, an address was delivered by Dr. Wernick on "British Practice in Metal Finishing" and this was followed by a short talk by Mr. Wm. Phillips on "American Practice."

Dr. Wernick's talk was illustrated by lantern slides and a film and was of considerable general interest.

### Cincinnati Branch

Despite the lateness of the season and the fact that platers do not ordinarily turn out to hear a talk on buffing, the Cincinnati Chapter of the A.E.S. had a record attendance at its last meeting on May 23. A splendid dinner was thoroughly enjoyed by some 46 hungry members after which they adjourned for the meeting which was called to order by President *Robert Miller* with 17 additional platers, polishers, and friends on hand. The Secre-


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No. 3. Suggestions for Planning a Barrel Finishing Department.

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tary was asked to read a letter from the Waterbury, Conn. Branch on the controversial Boston amendment, and one from this chapter which was addressed to the Executive Board of the A.E.S. and to all Branches.

*Mr. W. L. Morgan*, of the *J. C. Miller Co.*, Grand Rapids was introduced as our speaker on "Buffs". Touching on the early methods of polishing, Mr. Morgan stated that buff costs are affected by the condition of the castings, and the desirability of using the proper size grain in polishing operations, usually a finer size of grain. He felt that grease stick could be used to much greater advantage in the polishing room, and highly recommended at least one variable speed lathe in the polishing department. He further advised the necessity of a polisher always pushing down on the last stroke rather than pulling up.

He concluded his talk with an explanation of the different grades of materials available for buffs, and the significance of having the proper buff speeds.

*Mr. R. V. Twyning*, also of the *J. C. Miller Co.*, discussed the development of liquid buffing compounds, delivering a technical talk on their usage and application.

After the usual question period, the Branch enjoyed a Social Hour as the guests of the *J. C. Miller Co.*

### Chicago Branch

The officers were very pleasantly surprised at the large attendance (150) at the May meeting. They had anticipated the kind of enthusiasm children have for visiting the dentist, —their reason, a National officer was going to explain fiscal policy and the need for raising the dues.

It must be that First Vice President *Cleve Nixon* has that well known painless method. There were some vigorous and pointed questions from the floor, but most were convinced that under some modifying restrictions an increase in dues was necessary.

The speaker for the educational session (not that Cleve wasn't educational) perhaps compensated the business aspects of the program. He was *Mr. Kirkpatrick*, of the *F. B. Stevens Co.* who spoke on "Ventilation."

Being of the rugged type, the platers felt at home with him and at his invitation shot questions at him during his talk. His answers showed he was of wide experience and well qualified, both from a theoretical and practical viewpoint, to answer them.

### New York Branch

During the month of May, the New York Branch held two meetings. The first meeting was highlighted by a talk by *Dr. Wernick*, of England, who discussed the various new developments in the metal finishing industry in his country. Among these newer items was an automatic current density regulator and a nickel-tin alloy which may be plated directly from a solution at fairly high current densities and efficiencies. Dr. Wernick then showed a film on the "Roto Dip" process by which automobiles are rotated on a spit through various tanks and spray chambers to clean, phosphate coat, and apply a coat of primer to all surfaces of the car.

At the second meeting, eight new members were installed. These members are *Mr. Aisley, Mr. Mackay, Mr. Barsky, Mr. Smith, Mr. Cicio, Mr. Zminkowski, Mr. Fuhr and Mr. Dieckmann. Mr. Amatore* gave the final financial report on the New York Branch


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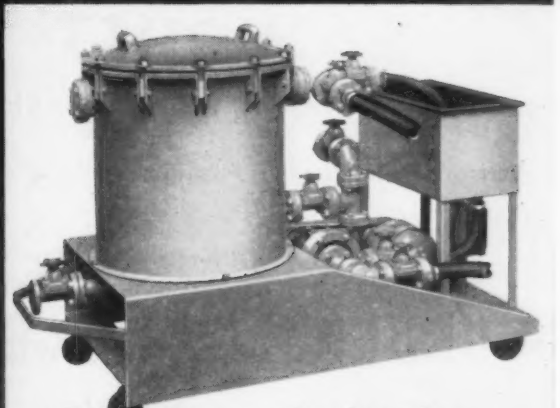

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Banquet which was held on February 17th. The business meeting was followed by a very enlightening talk by *Dr. Abner Brenner,* of the National Bureau of Standards, who spoke on the various properties of electro-deposited metals. This talk, accompanied by slides, went into such things as the crystal structure of electro-deposited metals and the variation in this crystal structure as a result of heat treatment. Dr. Brenner further illustrated his talk by a great number of samples which were passed around to the membership.

**Baltimore-Washington Branch**

The May meeting consisted of an afternoon tour through the Point Breeze Works of the *Western Electric Co.* on Tuesday, May 15th.

The thirty-six members and guests who attended were broken up into groups of six and treated to a most complete tour of all shops.

In the Cable Shop they were shown drawing and insulating of copper wire for conductors, sheathing of stranded cable with extruded lead jacket, and also assembly of coaxial cable for television transmission.

On traveling through the Station Shops they saw piece part making, assembly, and finishing for the various cable connecting devices. It is in these shops that the hardware is made and barrel plating shop operated.

The tour was finished by passing on to the Cord and Wire Shops, where are operated the continuous mills for mixing and applying Neoprene and plastic insulation to wire which had been lead and brass plated.

After finishing the tour, the officers retired to a quiet spot to rest their feet and make arrangements for a summer meeting of officers. At this summer meeting they plan to discuss the problems before the Buffalo convention so that the delegates may be further instructed.

**Los Angeles Branch**

The Los Angeles Branch of the AES closed out the first half of the year with a bang-up meeting when nearly 100 members and guests appeared at the June 13 gathering in Rodger Young Auditorium. The attraction was *Dr. C. L. Faust,* of Columbus, Ohio, a recognized international authority on electrochemistry, supervisor of the electrochemical engineering division of the *Battelle Memorial Institute* and past-president of the *Electrochemical Society.*

Dr. Faust's subject was "*Electrochemical and Chemical Polishing of Various Metals.*" He stated that while interest in electropolishing of metals first was aroused a decade ago, the real activity with the process began after the start of World War II. There is no doubt that, today, electropolishing has found a place in industrial finishing, Dr. Faust declared. Installations is used today range from 50 gallons to 24,000 gallons; the number of parts handled from 10 per day to 1,000,000 per month.

Dr. Faust cautioned that there is no possible way for an electrolytic process to produce a wheel-buff appearance, and the first thing that must be remembered is that it is a mechanical polishing process.

Dr. Faust rounded out his remarks by showing slides and samples of various types of metals which had been polished electrochemically. The slides showed such things as the luster that is obtainable by electrochemical polishing on stainless steel; polishing steel roller bearings; racking method


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for aluminum flashlight reflectors. Of much interest were views of the interior of job shops showing installations for electrochemical polishing. The speaker also gave some figures on the costs of this method of polishing.

*Roy Lostutter* presided over the business session. The first order of business was the introduction of a lengthy list of guests by *Frank Virgil*, sergeant-at-arms. Guests included *Ed Nicodemus*, Hughes Aircraft Co.; *Harold Wannamaker*, Avalon Plating Co.; *Marshall Blane*, *Robert Streeter* and *Frank Voorhees*, Turco Products; *William Heinicke*, *Jule Charles* and *Wilbur Simms*, Kwikset Locks, Inc., Anaheim; *John Niles*, Progressive Plating Co.; *J. E. Buchanan*, Lumidor Manufacturing Co.; *Joseph Swick* and *Jack Burns*, Artcraft Plating Co.; *Harold Smaller*, *Milton Wolfson* and *Robert Weinert*, U. S. Naval Ordnance Station, Inyokern, Calif.

San Francisco Branch's request for Los Angeles to serve as its proxy at the Buffalo convention was approved. The proposal of the board of managers that each delegate to the Buffalo convention be given $150 toward expenses was passed. The delegates were left uninstructed and with the privilege of exercising their own judgment with respect to the proposal of Boston Branch to increase the per capita tax by $2.80. Sentiment of the branch, on the whole, was opposed to the increase. Various members declared that further increasing of dues would be a deterrant to obtaining new members and would keep out of the AES many shop owners and workers who might have joined if the dues remained reasonably low. The feeling of some local members was that if the Supreme Society can prove that more dues are necessary to run the organization, they would favor it, but not if the added money is to be used to build up a huge reserve fund.

*Dexter Haldin*, chairman of the Summer Picnic Committee, announced that the 1951 outing was to be held Sunday, August 12 in South Gate Park, South Gate, Calif. The athletic feature of the outing will be a baseball game in which a team composed of plating shop owners and employees will endeavor to massacre a team of supply house representatives, with a minimum of physical exertion for all parties concerned.

Haldin announced that rules will be enforced this year. Anyone hitting a three-bagger will have to travel to third via first and second, and not direct from home to third, as some short-cutters like *John Millhorn* and *Howard Woodward* attempted to do in past games. *Don Bedwell* has been named umpire, and has announced that he will see to it that skullduggery is held to a minimum.

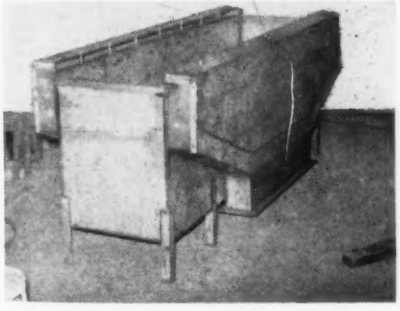
### So. Cal. Metal Finishing Ass'n.

*The Metal Finishing Association of Southern California* held a general discussion on the new M-Orders and on recently issued Government regulations affecting the finishing industry, at its June meeting held in the Rodger Young Auditorium, Los Angeles.

*Jack Raskin*, of the L. H. Butcher Co., chairman of an association committee which checks into the status of industry conditions and reports monthly to the membership, gave short reports on the availability of various metals. These were:

Cadmium—plentiful on the West Coast for DO rated orders.

Nickel—scarce and getting scarcer.

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### Cook Receives Annual Galvanizers Award

For distinguished service in the field of galvanizing, *Nelson E. Cook*, General Superintendent of Galvanizing for *Wheeling Steel Corp.*, recently received the 1950 Annual Award of *The Galvanizers' Committee*, sponsored by the *American Zinc Institute*.

Mr. Cook received the bronze plaque and citation during a two-day meeting of both groups at the Statler Hotel in St. Louis, attended by more than 250 leaders of the galvanizing and steel industries. *Mr. L. C. Flickinger*, Chairman of The Galvanizers' Committee made the presentation.

Nelson's father, the late *William J. Cook* was also a nationally recognized authority on galvanizing processes, and was known affectionately in the industry as the "dean of galvanizers."

Nelson E. Cook (left), General Superintendent of Galvanizing for Wheeling Steel Corporation, receiving 1950 Annual Award of The Galvanizers' Committee from L. C. Flickinger, Chairman.

After helping to organize the Galvanizers' Committee of the American Zinc Institute in 1936, Nelson E. Cook served as Chairman for five terms. He is at present a member of the governing board.


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## Letters to the Editor

*Mr. Walter A. Raymond, Editor*
*Metal Finishing*
*New York, N. Y.*

*Dear Mr. Raymond:*

The shop problem in your June issue regarding zinc plating over cast iron requires further clarification, in my opinion. The reader inquired as to why cast iron could not be plated with zinc in a cyanide bath.

The continued ignorance of the plating fraternity is at times pitiful. This problem was solved almost 30 years ago when a patent (1,451,543) was granted to the writer for a process for doing this.

Your answer mentioned flash coatings of other metals before zinc plating; in my opinion none of these flash coatings are of any real value, and are only ducking the issue. Neither do I believe that the report by *Diggin* mentioned in your reply clarifies the situation measurably.

The statement that "the difficulty revolves around the low hydrogen overvoltage of zinc in cyanide solutions" is meaningless; it should say "the difficulty is due to the low overvoltage of hydrogen upon the cast iron cathode in a zinc cyanide solution."

*Very truly yours,*
JOSEPH HAAS

*Walter A. Raymond*
*Editor, Metal Finishing*
*New York, N. Y.*

*Dear Walter:*

The article by *Mr. Joseph Haas* on "*Electroplating Stainless Steels*" in your June issue was very interesting and informative. This is the type of direct, practical and helpful paper that platers will find of considerable value, in their day-to-day operations. I should like to point out however, an omission in Mr. Haas' excellent literature review—Patent No. 2,227,454 (U. S., Jan. 7, 1941) for gold plating on steel and ferrous alloys such as stainless steel, granted to this writer, and assigned to *A. Robinson & Son*. This involved the use of a fluosilicic-hydrofluoric acid activating dip plus subsequent gold plating in a bath containing benzoates and formates.

*Sincerely yours,*
JOSEPH B. KUSHNER

## Obituary

### Thomas P. Kellogg

Thomas P. Kellogg, vice-president and assistant secretary of the *Apothecaries Hall Co.*, of Hartford, died of a heart attack recently at the Waterbury Hospital.

Mr. Kellogg was a graduate of Princeton and Harvard Business School, and became associated with Apothecaries Hall in 1929.

Mr. Kellogg was President of the Waterbury Club, a past director of the Waterbury Country Club, and a director of several banks in Waterbury. He is survived by his widow and three children.


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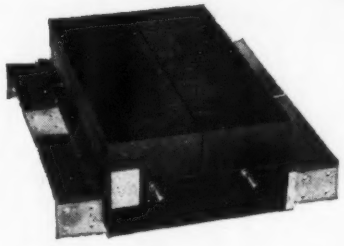

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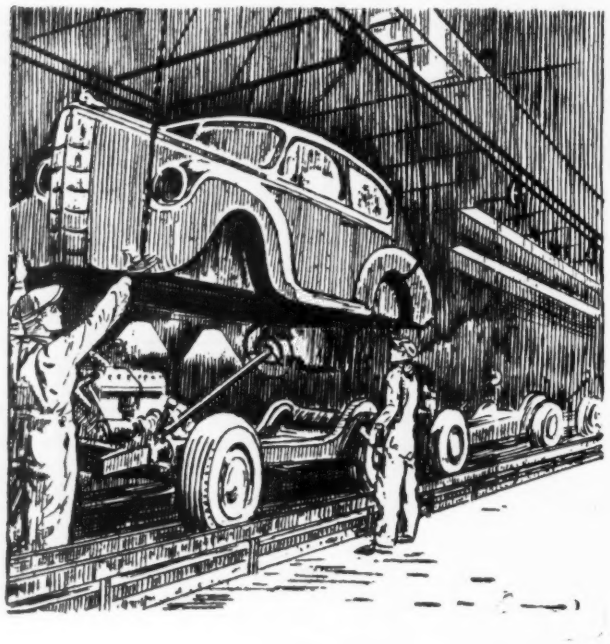

# MOTOR CITY PLATING NEWS

by

Edward Finne

July 21st is the date for the biggest and best social event of the AES. Detroit then puts on its annual Stag Day at the Forest Lake Country Club and the entire AES membership is invited to attend.

Games — Entertainment — Beer — Golf all throughout the day with the traditional fine steak dinner winding up the proceedings are offered for the sum of $6.00. Tickets can be obtained from *Frank Clifton*, 16536 Inverness, Detroit 21, Mich.

*********

*R. F. Glass*, formerly General Manager of *Metals Plated Co.*, has been promoted to assistant to *Norman Garvey*, vice-president of National Plated Products, 4019 Beaufait, Detroit. Garvey is also vice-president of a combine of 16 plants located throughout the country of which Metals Plated and National Plated are members. Mr. Glass will work on customer relations


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and union activities for the entire combine. His headquarters will be at the Beaufait address.

*********

*Henry C. Speel* has been named director of the development department of *Wyandotte Chemicals Corp.* His duties will include the introduction, market development and technical service of new organic chemical products.

*********

*The Ford Motor Co.* has outlined a $2,500,000 program to the Michigan State Water Resources Commission to control industrial wastes flowing into the Rouge River. The work, which is expected to be completed in 2½ years, will mark a sharp gain toward cleaning up Michigan's biggest single source of industrial pollution.

*J. A. MacAlarney*, chairman of Ford's industrial waste committee, outlined specific steps to control wastes and set definite dates for the completion of various projects.

*********

*Wm. Neil*, Supreme President of the AES, was honored in a surprise move at the May 18th meeting of the Detroit Branch. In advance of the usual date, he was admitted to the organization called the *Knights of the Pot*, and was given his certificate by *Walter Pinner*. This organization was created as an advisory group to the executive board of the Supreme Council, and is composed of past supreme presidents.

AES President Bill Neil acknowledges receipt of membership in The Knights of The Pot. Walter Pinner is behind the mike, and Dr. S. Wernick is seated at right.

Dr. Wernick presents certificate of Honorary Membership in the ETS to Walter Pinner.

*Dr. S. Wernick* then gave an address titled "*A Review of British Metal Finishing Practice.*"

Following Dr. Wernick's talk, a film was shown on the *Roto-Dip* phosphate process. In this process complete car bodies are taken through a phosphating cycle on a completely automatic conveyor.

*Mr. Williams Phillips*, of General Motors, next talked mainly on todays poor bright plating as compared to this type of plating 25 years ago and his talk was illustrated with slides.

Following a discussion period, *Dr. Wernick* pulled another surprise. About 4 years ago, *Walter Pinner* made a trip to Europe as a representative of the AES to study European plating practices and, while in England, made such an impression that he was given honorary membership in the Electrodepositors Technical Society. However,


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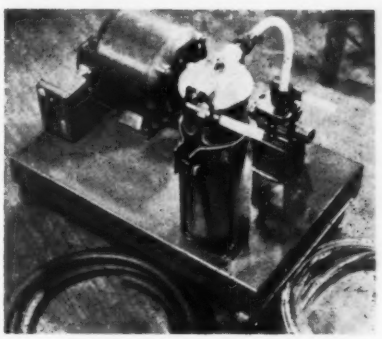

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he never was awarded his official certificate. Dr. Wernick, at this meeting, presented this certificate to the surprised Walter who was the first American to be so honored.

Refreshments followed this unusual meeting.

## Technical Literature

### Sub-Contracting Pointers for the Small Plant

*Pub. by the N.P.A. Office of Small Business, Wash. 25, D. C. Free.*

Contains information of value to small shops planning sub-contracting operations. Information on prime contractors, equipment, problems encountered by small plants, working capital, etc. are given.

### Protecting Against Sabotage

"Protecting Your Company's Security," a 13-page "blueprint" is being distributed to member companies by the *Research Institute of America.* The "blueprint" was prepared because investigation by the institute's research staff showed that no company is entirely safe from Communist sabotage, fifth-column activity and espionage.

Pointing out that there are some precautions every company should take, the report discusses methods of determining whether or to what degree a company is vulnerable; policy adjustments; setting up a security program; selecting and installing a security officer; tracking down Communists, fellow-travelers, espionage and sabotage; working with the union; getting help from government agencies, and the supervisor's or forman's part in carrying out security measures.

Single copies of "Protecting Your Company's Security" are available without charge. Requests should be sent to Member Relations Division, *Research Institute of America, Inc., 292 Madison Ave., New York 17, N. Y.*

### Small Business Mobilization Guide

A 31-page guidebook, designed to help the small manufacturer during the defense mobilization period, was issued recently by the Defense Production Administration.

*J. C. Pritchard*, Deputy Administrator for Small Business, described the guidebook, "*Mobilization Guide for Small Business,*" as a quick source of help to businessmen in locating services the Government is providing so that they can share, so far as requirements exist and their capabilities permit, in defense orders and in obtaining materials available to supply consumer requirements.

The guidebook is obtainable at all field offices of the Department of Commerce. It contains such information as: How to be placed on Government bid lists; methods of financing plant construction; how to appeal for "hardship relief" from controls and regulations; and means of getting help in obtaining needed machinery and operating supplies.

The booklet also lists locations of field offices of the Department of Commerce and Department of Labor, the 10 regional offices of the General Services Administration, which handles non-military procurement for the Government, and the offices of the Reconstruction Finance Corporation.

## PATENTS

### High Speed Safety Buff

*U. S. Patent* 2,531,249. *J. D. Blair and G. A. Hendey, assignors to Divine Bros. Co.*

A buff construction characterized by a relatively high degree of safety and resistance to disintegration by centrifugal forces during high speed rotation, said buff construction comprising an annular body of woven textile material formed from a plurality of layers all wrapped around substantially a common fold line near the inner edge of said annular body, a stabilizing ring of metal extending integrally and continuously around said body approximately at said fold line in such position that each of said layers of textile material is wrapped around said ring, a metal mounting plate having a main plane located substantially midway of the thickness of said annular body and having at its periphery a series of internal marginal ears alternately bent laterally in opposite directions from said main plane to form collectively a seat for the inner edge of said annular body and thence bent rapidly outwardly along a face of said annual body to


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prevent axial displacement of said annular body from said seat, the outer ends of said outwardly extending ears being located outwardly beyond the outer edge of said stabilizing ring, and metal staples anchored in said outwardly extending ears and extending through said ears and through the thickness of said annular body in positions outwardly beyond the outer edge of said stabilizing ring.

### Removing Fluorides From Water

*U. S. Patent* 2,531,451. *F. J. Maier.*

The method for the removal of fluoride ions from water which comprises the steps of treating a fluoride containing water with alum and clay at a pH of between about 6.0 to 7.0; adding an activated silica sol to the thus treated water; and permitting the water to pass thru the thus formed floc substantially as described.

### Immersion Nickel Plating

*U. S. Patent* 2,532,283. *A. Brenner and G. E. Riddell.*

An autocatalytic chemical reduction process for continuously plating nickel on metallic objects consisting essentially of a metal selected from the group consisting of iron, platinum, silver, nickel, gold, cobalt, palladium, aluminum, and copper, said process comprising the steps of: providing an aqueous solution of a nickel salt and an alkaline hypophosphite, the nickel ion being present in an amount not substantially in excess of about 3 parts by weight to about 100 parts by weight of said solution, the hypophosphite radical being present in an amount not substantially in excess of about 3 parts by weight to about 100 parts by weight of said solution, immersing an object of one of said metals in said solution, nickel plating said immersed object by autocatalytic reaction of said salt and said hypophosphite, removing said plated object from said solution, maintaining said solution throughout the period of said immersion at a temperature in the range of about 90 degrees centrigrade to about 100 degrees centigrade and at a substantially uniform pH value in the range of about 3 to about 9 by the presence in the solution of at least one of the salts selected from the group consisting of sodium salts of carboxylic acids and ammonium salts, and introducing throughout said immersion period and at substantially regular intervals additional hypophosphite into said solution in amounts of about 5 grams per liter of said solution.

### Immersion Cobalt Plating

*U. S. Patent* 2,532,284. *A Brenner and G. E. Riddell.*

An autocatalytic chemical reduction process for continuously plating cobalt on metallic objects consisting essentially of a metal selected from the group consisting of iron, nickel, cobalt, palladium, and copper, said process comprising the steps of: providing an aqueous solution of a cobalt salt and an alkline hypophosphite, the cobalt ion being present in an amount not substantially in excess of about 2.5 parts by weight to about 100 parts by weight of said solution, the hypophosphite radical being present in an amount not substantially in excess of about 10.7 parts by weight to about 100 parts by weight of said solution, immersing an object of one of said metals in said solution, cobalt plating said immersed object by autocatalytic reaction of said salt and said hypophosphite, removing said plated object from said solution, maintaining said solution throughout the period of said immersion at a temperature in the range of about 90 degrees centigrade to about 100 degrees centigrade and at a substantially uniform pH value in the range of about 8 to about 11 by the presence in the solution of at least one of the salts selected from the group consisting of sodium citrate Rochelle salts and ammonium chloride, and introducing throughout said immersion period and at substantially regular intervals additional hypophosphite into said solution in amounts of about 5 grams per liter of said solution.

### Contour Polishing Attachment

*U. S. Patent* 2,532,500. *L. D. Jensen, assignor to Dover Industries, Inc.*

In a machine of the character described the combination of a housing, an endless belt and a plurality of rollers over which said belt is trained, drive means for one of said rollers, adjustable mounting means for said drive means and said one roller a mounting integral with said housing, a bearing plate adjustably slidably mounted on said mounting, a bearing bracket adjustably rotatably mounted on the bearing plate, a journal on said bearing bracket, a spindle mounted in said


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journal and extending into the housing, a contact wheel on the extended spindle end in circumferential surface contact with the belt surface, mechanical means to rotate said bearing bracket to adjust the plane of the contact wheel circumferential surface relative to the belt surface plane, and mechanical means for slidably adjusting said bearing plate toward or away from said belt.

### Plating Rack

*U. S. Patent* 2,532,516. *M. S. Schneider.*

A rack adapted to be suspended and to support a plurality of articles in an electroplating bath or the like having a transverse bus bar over the same comprising, in combination, a pair of closely adjacent metal bars in parallel alignment and electrical engagement with each other, said bars being relatively adjustable longitudinally, one of said bars having a hook at its upper end adapted to hook over the bus bar and thereby to supportingly suspend the rack in the bath and electrically connect it with the bus bar, transverse arms with article-holding free ends secured centrally to said bars in a plurality of groups of three arms each, a pair of the arms of each group being secured to one of said bars and the other arm of each group secured to the other bar, the free ends of said pair of arms forming a support for the lower edge portion of an article to be plated, said free ends each having an article edge receiving notch in the upper surface thereof and said free ends being laterally bendable to enable them to be spaced apart as desired to hold the particular article, the free end of the other arm of each group being resilient and located above said pair of ends and adapted resiliently to engage and hold the upper edge portion of the article and press it down against said pair of ends during plating, said upper resilient end having a series of article edge engaging depressions on its lower side to accommodate aritcles in different inclinations to the vertical for rim drainage, said resilient ends enabling the articles to be individually loaded into the respective groups of the rack, a handled lever pivoted to one of said bars and lying alongside thereof when in closed position, and a link pivoted at one end to the other of said bars longitudinally beyond the pivot of the lever, the other end of said link being pivoted to said lever toward the handle end thereof and inside a line joining the pivots of the link and the lever to the bars, said link being longer than the distance from its pivotal attachment on the lever to the pivot of the lever, whereby pivotal movement of said lever from and to its closed position imparts a longitudinal relative shifting of said bars to free the articles from the ends of said arms and to reset said ends in article-holding position, said lever and link connections preventing the shifting of the bars in a direction to free the articles when the lever is in closed position.

### Polishing Machine

*U. S. Patent* 2,532,581. *M. V. Triggs.*

A polishing machine, including a turntable formed with openings for receiving work, a polishing wheel positioned above the turntable openings for receiving work, a dirigible carriage, means for mounting the carriage above said turntable and for diametric movement relative to said turntable: an electrical motor and its shaft supported on the dirigible carriage, means between the motor shaft and said polishing wheel for rotating same when the motor is energized, and a freely movable swing support carried by the motor shaft for the polishing wheel.

### Conveyor for Plating Holloware

*U. S. Patent* 2,532,849. *C. Manaseri, assignor to Oneida, Ltd.*

In a device for automatically moving an article through a row of processing zones, while swinging said arti-

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cle upwardly at substantially the end of its travel through each one of said zones and then downwardly into position for traversing the next succeeding zone, the combination of carriage means actuated by driving means moving said carriage means at a substantially constant speed substantially parallel to the axis of said row of processing zones, said carriage means supporting a holder for said article, said holder being swingably pivoted intermediate its vertical length at one end of said carriage means to depend vertically and to permit swinging about the point of pivoting in a plane at right angles to said axis, a roller positioned adjacent the end of said carriage means opposite to said holder, and supported by said carriage, and so positioned that said plane passes through said roller, connecting means between said roller and a point on said holder above the point at which said holder is pivoted to said carriage means, a surface along which said roller rolls, the normal course of said surface being parallel to the line of travel of said carriage means, and deflections in said surface for causing said roller to move horizontally away from said holder at each of the intervals between each adjacent pair of said processing zones, said horizontal movement of said roller causing its associated holder and the article held thereby to swing upwardly out of the processing zone just traversed and into a substantially horizontal position.

### Plating Rack Design

*U. S. Patent* 2,533,464. *J. W. Jasper, assignor to Eastman Kodak Co.*

A rack for supporting in electroplating operations flat metal work pieces which have a pair of laterally spaced apertures adjacent the upper end thereof, comprising a rectangular rack body having an integral supporting hook on one end thereof, said rack body having a pair of parallel vertically extending and horizontally spaced slots positioned adjacent the upper end thereof, a separate clamping screw member positioned in each of said slots and adapted to the adjusted longitudinally thereof and to pass through the corresponding aperture in the work piece, a pair of upright U-shaped plate members secured to and spaced apart from the opposite end of said rack body on opposite sides thereof by spacers terminating below the upper edges of said plates to provide a horizontal slot on each side of said rack body each of said horizontal slots being adapted to receive the lower end of a work piece, a third clamping screw member extending through the portion of the rack member located between the respective arms of the U-shaped members and adapted to exert clamping pressure on the rack member and the lower end portion of the work piece resting in the horizontal slot, all of said screw clamping members being adapted to hold cooperatively portions of a flat metal work piece against the plating rack in good electrical contact.

### Cathode Rod Agitation

*U. S. Patent* 2,534,165. *C. L. Fread, assignor to Gerity-Michigan Corp.*

In combination with an apparatus for moving work pieces longitudinally through an elongated electroplating tank comprising an endless chain at each side of said tank, power carrying buss bars at each side of said tank, work holding electrode rods spanning said tank from side to side, means for supporting the ends of said electrode rods upon the buss bars and in constant sliding contact therewith, and means attached to said endless chains for sliding said electrode rods along said buss bars, eccentric means to impart vertical reciprocation to said buss bars while the rods remain in sliding contact therewith, and shock absorbers mounted on said tank and attached to said buss bars to partially restrain the downward movement of said buss bars and said electrode rods.


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1—**7500/3750 Ampere, 6/12 Volt, A. P. Munning "Optimus."** Complete Controls.

1—**6000 Ampere, 2-6 Volt, Jantz and Leist.** Separately Excited. Excellent Condition.

1—**6000/3000 Ampere, 6/12 Volt, Charles J. Bogue.** Synchronous Motor.

1—**5000/2500 Ampere, 6/12 Volt, Eager Electric Co.** Separately Excited. Excellent Condition.

1—**3000/1500 Ampere, 12/24 Volt, Hanson-Van Winkle-Munning Co.** Synchronous Motor. Exciter-In-Head. Excellent Condition.

1—**3000/1500 Ampere, 6/12 Volt, Hanson-Van Winkle-Munning Co.** Synchronous Motor. Full Control Equipment.

1—**2000/1000 Ampere, 6/12 Volt, A. P. Munning "Optimus."** Excellent Condition.

1—**1500/750 Ampere, 6/12 Volt, Hanson-Van Winkle.** Excellent Condition.

1—**1000/500 Ampere, 6/12 Volt, Electric Products Co.** Separately Excited. Excellent Condition.

1—**2000 Ampere, 50 Volt, Chandeysson Electric Co. Anodizing Unit.** Synchronous Motor. Full Controls.

2—**1000 Ampere, 30 Volt, Ideal.** Full Control Equipment.

1—**1000 Ampere, 40 Volt, Chandeysson Electric Co. Anodizing Unit.** Synchronous Motor Drive. Excellent Condition.

1—**400 Ampere, 40 Volt, "M.G.C."** Anodizing Motor Generator Set. Exciter-In-Head.

5—**Green Selectroplaters, 1800 Amperes, 12 Volts,** for operation on 220 volt, 3 phase, 60 cycle.

1—**General Electric Co. Copper Oxide Rectifier, 2000 Amperes, 6 Volts.** With 220 volt, 3 phase, 60 cycle input.

2—**Udylite-Mallory Rectifiers. 1440 Amperes, 6 Volts,** with 220/440 volt, 3 phase, 60 cycle input.

4—**General Electric Copper Oxide Rectifiers, 500 Amperes, 6 Volts,** for operation on 220 volt, 3 phase, 60 cycle.

1—**Udylite Semi-Automatic Plating Tank,** Koroseal-lined, size: 19' long x 5' wide x 4½' deep. Excellent Condition.

**M. E. BAKER COMPANY**
25 WHEELER ST., CAMBRIDGE, MASS.
KIRKLAND 7-5460